

# The Australian and New Zealand Journal of Surgery

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## DISEASES OF THE DUODENUM.<sup>1</sup>

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THE first portion of the duodenum, in many respects, is the most remarkable segment of the entire gastro-intestinal tract. Although this section of the duodenum has the same embryological development and blood and nerve supply as the stomach, it is sharply distinguished from the stomach by important anatomical relationships. In the physiology of digestion this portion of the duodenum has a major rôle in maintaining normal gastric function. In its pathological processes it presents difficult problems. It is by far the most common site of inflammatory lesions of the gastro-intestinal tract, and at the same time it is practically immune to tuberculosis, sarcoma and carcinoma. The inflammatory lesions of this portion of the bowel and their complications exhibit great variability in their clinical manifestations and in their response to treatment.

The incidence of such inflammatory processes can only be conjectured. It is known, however, that they are ten times as common as benign lesions of the stomach and that they can be demonstrated at necropsy in about 18% of adults. Adding to this the fact that slight inflammatory reactions of the duodenum can disappear without scarring, it is safe to say that the inflammatory processes of the duodenum represent the most common intraabdominal disease.

Such lesions of the duodenum exhibit wide variations and are practically confined to the first two centimetres below the pylorus. Rarely do lesions involve the ampulla of Vater, and beyond this point they are almost unknown.

The multiplicity of lesions found in cases of long-standing chronic duodenal ulcer is one of the characteristic features of the disease. In

<sup>1</sup>Read at the annual meeting of the Royal Australasian College of Surgeons, Melbourne, on March 5, 1935.

the duodenal wall, both on operation and at necropsy, frequently there are revealed many scars and the contractions which have followed them. Robertson has mentioned the duodenum as the battle-ground of inflammatory processes, and some recent reports indicate that multiple lesions, healed or unhealed, are almost always present.

The type of inflammatory lesion of the duodenum varies as markedly as do the symptoms and the clinical manifestations of the disease. The more extensive lesions are linear and stretch transversely across the posterior wall of the duodenum, but more commonly the ulcers are circular and are generally distinct. In some instances the lesion extends entirely through the wall of the duodenum and the base is on, or in, the substance of the pancreas. There always is a distinct increase in the number of Brunner's glands, with marked fibrosis between the lobules, and always marked lymphocytic invasion throughout all the coats of the duodenum. In the mucosa are to be found plasma cells, eosinophile cells, and a large number of polymorphonuclear leucocytes, and in the less chronic conditions there is great activity of glandular epithelium, as is evidenced by the presence of regenerative cells and many mitotic figures.

The reverse of this picture is the localized inflammatory reaction of the wall of the duodenum, the clinical significance and treatment of which have been the subject of much controversy. This inflammation may be entirely localized in the mucosa, and in general may correspond to that accompanying true duodenal ulcer, although the musculature is not involved. It is still fair to assume, however, that there is a definite relationship between duodenitis and duodenal ulcer, and that chronic duodenitis is a precursor of duodenal ulcer, and as such deserves the same attention as do the early manifestations of any other chronic disease.

The cause of inflammatory lesions of the duodenum is a complex problem. The characteristics of duodenitis imply that the disease is of bacterial origin. It is a common observation that acute ulcerations of the gastric or duodenal mucosa may be associated with acute infectious diseases and localized infective processes. The work of Rosenow certainly suggests that such acute ulcerations are dependent on elective localization of streptococci. This type of ulceration readily is produced experimentally by intravenous injections of various pathogenic organisms and by many other means, and it is probable that these acute erosions are exceedingly common in adult life. It is in the inability of these erosions to heal and disappear that the real cause of chronic peptic ulcer probably must be found.

In some respects the problem of inflammatory lesions of the duodenum is simple, but in others it is a most complex one. All clinical and experimental evidence shows conclusively that it is almost impossible for an ulcer to form in the absence of acid. Acid, therefore, is the most common constant factor. Moreover, a mechanical factor apparently is necessary. The chief clinical evidence to support the acid



factor is that the control of acidity by either medical or surgical means is followed, in a large percentage of cases, by healing of the ulcer. From an experimental standpoint the evidence is even more convincing, for it has been shown that elimination of the alkaline mechanism in the duodenum, with direct union between stomach and jejunum, routinely will bring about an ulcer comparable to that seen in man. The problem of aetiology becomes complex when one endeavours to determine why the individual patient should develop duodenal ulcer. It is in attempts to elucidate this phase of the problem that so many possible contributory factors have been suggested.

The clinical manifestations of inflammatory lesions of the duodenum are as varied as are the lesions. The well-known syndrome of uncomplicated duodenal ulcer is pathognomonic of the disease; the sequence of food-ease-pain-food-ease-pain is typical of no other condition except of an organic lesion of the stomach or duodenum. The cause of distress which is associated with duodenal ulcer has been the subject of much discussion, and it is now well recognized that the symptoms are not synonymous with the disease, but are attributable to disturbance of gastric function, namely, hyperperistalsis and intragastric spasm. The severity of symptoms of uncomplicated ulcer varies strikingly. It is not uncommon, for example, that an ulcer is completely silent until serious hæmorrhage or perforation has occurred, and the reverse may be true, in that an ulcer may be associated with severe dyspepsia without development of complications.

The curious characteristic of a typical inflammatory lesion is intermittency of symptoms. There is little doubt that the alternating presence and absence of symptoms is not necessarily connected with activity in the area of inflammation, and it is a common observation that patients who suffer acutely from duodenal ulcer can be relieved of symptoms immediately by a vacation or even by planning a vacation. The intimate relationship, therefore, between symptoms of ulcer and psychical factors is clear.

The three major complications of inflammatory lesions of the duodenum are: perforation, hæmorrhage, and obstruction. Ulcers of the perforating type usually are protected either by the gastro-hepatic omentum, the gastro-colic omentum, or the head of the pancreas. Only if an ulcer is on the anterior wall, where perforation is a catastrophe, is prompt closure required to save the life of the patient. Perforations vary greatly in extent and activity and represent a type of lesion the symptoms of which usually can be permanently controlled by surgical interference. The protected perforation can be recognized, as a rule, by the fact that the pain, previously associated with the lesion, becomes more severe and extends more widely than if the lesion had not perforated.

Hæmorrhage occurs in about 20% of the cases in which operation becomes necessary, and in about 8% of cases in which duodenal ulcer is diagnosed. Hæmorrhage from duodenal ulcer usually is manifest by melena only; in a small percentage of cases the blood is both vomited

and passed by bowel, and most rarely is only vomited. A single hæmorrhage rarely is fatal, although some recent publications in *The British Medical Journal* and *The Lancet* have shown that in selected groups of cases of severe hæmorrhage the mortality varies between 10% and 22%. Death from hæmorrhage, however, usually is attributable to repeated hæmorrhages, and yet this also is rare in duodenal ulcer. The serious hæmorrhages are those from lesions of the posterior wall of the duodenum, not only because its blood supply is greater than that of the anterior wall, but also because the posterior wall is more fixed and therefore is less able to contract. The bleeding is not always from the ulcer itself, but from the congested tissues about the ulcer; the resultant oozing is not associated with any actual erosion of a vessel. The liver and spleen, or both, may be significant in production of hæmorrhages, and extrinsic causes of hæmorrhage must always be considered, even though a lesion may be demonstrated in the duodenum. It is most important to remember, however, that in by far the majority of cases of gastro-intestinal hæmorrhage there is some inflammatory condition in the stomach or duodenum.

It is an interesting clinical fact that hæmorrhage, in cases of duodenal ulcer, usually is followed by a long period of remission of symptoms. In those cases in which hæmorrhage is the most dominant sign of ulcer, symptoms being mild or entirely lacking, the diagnosis rests on the Röntgenological findings, and on the fact that the most likely cause of hæmorrhage is a lesion of the stomach or duodenum.

Obstruction of some degree is a complication in about 20% of cases in which operation is performed. It may develop in any part of the first portion of the duodenum, and usually it is attributable to the scarring resulting from attempts at healing, but in many cases it is the result of œdema from temporary exacerbation of the inflammatory process. The latter type is amenable to intensive medical treatment, but obstruction, whatever its nature, is prone to recur and constitutes the most logical indication for surgical interference. Ulcers of long standing, particularly when multiple, may be associated with great deformity; one of the most common deformities is pouching of the duodenal wall, on both superior and inferior borders of the duodenum, producing a characteristically dumb-bell shaped duodenum.

The diagnosis of inflammatory lesions of the duodenum has become as accurate as the diagnosis of any intraabdominal disease, partly because the symptoms of the disease usually are characteristic, and partly because of the ability of the competent Röntgenologist to demonstrate, by direct and indirect signs, the presence of inflammatory conditions.

There are certain general principles in the management of duodenal ulcer which have become well established. In the first place, since it is not a malignant disease, and since the serious complications are relatively rare, emergency measures are required only in the event of acute perforation. In the second place, in a large percentage of cases

of duodenal ulcer, the disease may be controlled by adequate medical management. Marked advances have taken place in the medical treatment of duodenal ulcer. There has been better understanding of the course of the disease, and greater recognition of the fact that patients vary much in their response to treatment, as well as of the fact that it is a chronic disease with a marked tendency to recurrence; however, it is also recognized that such recurrence often can be more or less aborted by intelligent medical management on the part of the patient.

The fundamentals of treatment, of course, have not materially changed. Frequent feedings of an adequate amount of food have been shown to be very important, and Mann has demonstrated, in dogs, that feedings at frequent intervals are major factors in controlling gastric acidity. More recent developments in medical management have been the use of such buffer agents as mucin, and the use of extracts of duodenal mucosa; the latter has been shown experimentally to have inhibitory reaction on gastric secretion. Any new therapeutic measures, however, can find their true place in the management of the disease after a long enough time has elapsed to allow it to be determined whether any higher protection against reactivation has been brought about than by former methods. The early reports of the results of any treatment of duodenal ulcer must take into consideration the prompt relief of symptoms which usually comes only from rest.

It should be said, first, in considering the indications for surgical treatment of duodenal ulcer, that the surgeon is asked to deal with a disease after every other form of treatment has failed to bring about control of symptoms. He will be called on, therefore, to see those patients whose symptoms are so severe that relief cannot be obtained by medical management, those whose repeatedly recurrent attacks cannot be prevented, and those who are troubled by complications that are sufficient to call for surgical management.

The general principles of surgical management of duodenal ulcer as followed in America, I believe, are those which are practised by the surgeons in Australia and New Zealand. The most important principle is that there must be an adequate reason for operation; merely that a patient is found to have a duodenal ulcer is not sufficient reason to advise an operation. The most satisfactory results are obtained if the disease is in a late stage, so that the practice of postponing operation until chronicity has been established is wise. It is a curious fact that in cases of chronic duodenal ulcer, the greater the delay in carrying out surgical treatment, the more nearly certain it is that excellent permanent results will follow. If such practice is adopted, selection of the most effective operation will not be difficult, for it has been conclusively shown that the results of conservative procedures in diseases of long standing cannot be excelled.

The surgical management of duodenal ulcer would be simple, therefore, both in principle and in practice, if such favourable conditions were met in all cases, but neither the variability in the disease itself,

nor its complications, permit routine surgical treatment. It is those phases of the surgery of duodenal ulcer about which we are somewhat perplexed that I wish to discuss briefly.

Although it is true that chronicity is a first requirement for advising operation in cases of duodenal ulcer, there are occasionally circumstances in which operation is desirable in an early stage of the disease. It is this fact which made so interesting a debate conducted last year before the Royal Society of Medicine, for on the subject, "In the absence of complications operation for duodenal ulcer is inadvisable", a tie vote was given; this is an excellent illustration of the fact that rules cannot be applied invariably. Surgical treatment of duodenal ulcer, in its early stages, may be indicated in those cases in which symptoms are severe, the lesion is intractable to treatment, or the patient is unwilling or unable to persist in a satisfactory regimen. In such cases, because the patient is young and there is usually no motor impairment, and gastric secretion is hyperactive, gastro-enterostomy should be avoided, for the incidence of jejunal ulceration is high in such circumstances. The best procedure in my experience, in these cases, is wide removal of the anterior half of the pyloric muscle, with the adjacent portion of anterior walls of the duodenum and pyloric antrum, and reconstruction of the pyloric outlet. Such a procedure is safe, brings about reasonable reduction of the hyperactivity of gastric function, and, in the majority of cases, good symptomatic results. The operation has the great advantage of permitting further surgical management should the disease recur.

In contrast to these early cases, in which duodenitis is frequently a prominent feature of the pathological process, are those long-standing cases in which we encounter deeply penetrating lesions, obstruction, and the gastritis which is so commonly associated with such advanced disease. It is in this group of cases that surgeons of continental Europe have so strongly advocated partial gastrectomy, chiefly on the basis of the existing gastritis. It is unnecessary to point out to this audience that, regardless of the skill of the surgeon, the mortality of the radical operation, when routinely applied in such cases, is approximately five times that of the conservative procedures. Gastro-enterostomy in such cases not only deals effectively with the primary lesion, but also with any gastritis present, and the incidence of jejunal ulcer in this group of cases is negligible. Moreover, gastrectomy is not free of a definite percentage of disappointing results both in respect of relief of symptoms and to protection against jejunal ulceration. Chiefly for these reasons we believe that in long-standing cases of chronic duodenal ulcer gastro-enterostomy holds first place, and that gastrectomy is reserved for those cases in which the age, the type of individual, and the large size and fixation of the ulcer justify the more radical procedure when it can be carried out with safety.

The management of acute perforation should be conducted, I believe, on the premise that the immediate purpose of the operation is to save

the life of the patient. Nevertheless, European surgeons have again introduced more radical methods than simple closure of the perforation, and although some excellent results have been reported, I doubt if partial gastrectomy can ever match, in mortality, closure of the perforation. Similarly, gastro-enterostomy should be added to closure of the perforation only when it is obviously of no additional risk. Occasionally excision of the perforated lesion, with reconstruction of the pyloric outlet, is an excellent procedure, particularly when pyloric obstruction also is present, and when it can be carried out not only with safety, but with the assurance that motor disability will not recur.

The most difficult problem confronting the surgeon in the management of duodenal ulcer concerns those cases in which hæmorrhage has been a major factor in the complaint. In the first place, accurate differential diagnosis is imperative, and in addition to the rôle of the liver and spleen in gastric hæmorrhage, other extraduodenal lesions within the abdomen must be excluded. The most definite of these are lesions of the small intestine, such as tumours, ulcerations, or Meckel's diverticulum with aberrant gastric glandular tissue in its wall, lesions of the appendix, and so forth. Such lesions are so well concealed that repeated operations may be carried out, without avail, for a duodenal ulcer erroneously supposed to be responsible for the bleeding. It is imperative, therefore, in operating for hæmorrhagic duodenal ulcer, to recognize that some other lesion within the abdomen may be a factor, or possibly the only factor, responsible. This is particularly true in cases in which failure to control the bleeding has followed operation for the duodenal ulcer. This fact should not be emphasized beyond the point, however, that by far the most common cause of hæmorrhage is duodenal ulceration.

The treatment of acute hæmorrhage at present usually is non-surgical, since patients generally recover without operation. I believe, however, in exceptional cases, when the bleeding continues and the presence of an ulcer is known, that massive transfusion of blood, followed immediately by direct surgical attack on the ulcer, is sound treatment. It is an interesting fact that the greater the experience of the surgeon in this field, the more likely will he be to consider the advisability of operation in certain acute cases. The situation parallels that of pulmonary embolism, in which embolectomy becomes justifiable if the patient obviously is dying. If, in spite of repeated transfusions, circulation cannot be maintained, operation could be looked on as justifiable and should consist of a direct attack on the ulcer, either by excision or by suture.

In treatment of bleeding duodenal ulcer the indications for operative measures are clear if frank hæmorrhage has occurred, if the ulcer is chronic, and if the symptoms have been inadequately controlled. A massive hæmorrhage which apparently threatens the life of the patient, justifies operation even if other symptoms are slight or absent. Recurring hæmorrhage, with intervals of complete freedom from all symptoms

and complications, for varying periods of time, is adequate reason for operation.

A single hæmorrhage of moderate severity, if the patient suffers little inconvenience from the ulcer, is not sufficient grounds for advising operation. A difficult problem is presented by the patient who has recurring hæmorrhages, the cause of which cannot be established definitely because of the absence of other symptoms and because Röntgenological studies of the gastro-intestinal tract either reveal no abnormality or are inconclusive. Exploration should be advised in such cases, and a lesion of the duodenum probably will be discovered, usually of the posterior wall, and more distant from the pylorus than such lesions commonly occur. Although it apparently is true that a slight inflammatory process, without actual ulceration in the duodenum, may be responsible for a single hæmorrhage, and also may be difficult to detect at operation, it is also true that recurrences attributable to lesions in the duodenum are dependent on real ulceration, often completely concealed until the duodenum has been widely opened.

The successful surgical treatment of hæmorrhagic duodenal ulcer demands familiarity with various surgical procedures, their indications, and their proper performance. Gastro-enterostomy can fairly be placed first in importance, because of its safety, its applicability in all cases, and its efficiency in bringing about healing of the lesion, or lesions, in the duodenum. These facts give it very distinct advantages over all other operations. A review of the results of gastro-enterostomy (posterior or anterior) performed at the Mayo Clinic for hæmorrhagic duodenal ulcer five years or more after operation shows that 85% of the patients have had no further hæmorrhages and have had no further symptoms of ulcer; such results frequently deter the surgeon from attempting operations more radical in principle and consequently of greater risk. There are two main disadvantages of gastro-enterostomy. First, it may fail to prevent reactivation of the inflammatory process in the duodenum; I believe this is extremely rare if the gastro-enterostomy has been properly performed and the stoma continues to function well. Second, ulceration may recur in the jejunum. This complication occurred in about 4% of the cases in which gastro-enterostomy alone had been done for hæmorrhagic duodenal ulcer during a period of five years or more after operation. It is of interest to note, in such cases, that recurrent jejunal ulcer usually is of the bleeding type, and this adds to the probability that there is an abnormal tendency to bleed in certain cases of ulcer.

The principle of direct attack on the hæmorrhagic duodenal ulcer is logical. The advantages of thorough removal of the lesion, combined with a procedure which will prevent its recurrence, are obvious. Theoretically and in actual fact, complete excision of the ulcer, combined with gastro-enterostomy, satisfies both requirements, and when this can be done without introducing a too mutilating and, therefore, dangerous technical procedure on the duodenum, it becomes a most efficient method



of treatment. The obstacles to such treatment usually are technical, because of situation of the lesion, obesity of the patient, or fixation of the duodenum. Even if direct attack is interfered with by such conditions, partial removal, with deep sutures carefully placed on the vessels of the gastro-hepatic omentum leading to the site of the ulcer, is useful. Cautionary excision, followed by suture, can be employed satisfactorily as a quick and efficient method of treating lesions on the anterior wall in particular. For lesions on the posterior wall, awkwardly situated, it possesses definite advantages over other methods of excision. Direct excision also usually permits satisfactory inspection of the entire first segment of the duodenum, and the information thus acquired is of the greatest importance in solving the problem as to the most efficient treatment.

Another procedure which may be employed in the surgical treatment of hæmorrhagic duodenal ulcer is excision followed by reconstruction of the pyloric outlet. Such treatment is based on sound surgical principles, since in carefully selected cases it fulfils the major requirements of removal of the lesion, adequate modification of gastric physiological processes, and minimal risk. The advantage of thorough inspection of all of the first part of the duodenum is more positive with this type of operation, since with wide removal of the anterior half of the pyloric muscle and the adjacent portions of the anterior wall of the stomach and the duodenum, excellent exposure of the posterior wall of the duodenum is possible. The second advantage, namely, elimination of pylorospasm, in many cases at least, is of the greatest importance, since it accomplishes in these cases control of the disease. The risk of the operation, when cases are carefully selected, is less than that of any other procedure. In the last 400 operations of this type, excision followed by reconstruction of the pyloric outlet, the mortality was 0.27%, and the protection against further hæmorrhage was at least 70%. In cases in which recurrence takes place a different type of operation easily can be done and usually is followed by good results.

The principle of duodenal exclusion is one which merits attention, because inflammatory processes in the duodenum, when completely protected from gastric secretion, are almost certain to heal and remain healed. In the earlier application of this principle, as by the method of von Eiselsberg, by which the pylorus was divided, the disappointing results were attributable to the high liability to jejunal ulcer, because of the secretory products of the entire stomach being diverted into the jejunum. Devine modified this procedure by dividing the stomach well above the incisura, closing the lower segment, and restoring gastrointestinal continuity by some form of gastro-jejunostomy. Insufficient data concerning late results necessitate reservation of opinion as to the efficacy of this procedure in preventing development of jejunal ulceration, but it is most efficient in promoting healing of the primary lesion. Finsterer, in certain cases, employs the principle, but adds removal of the pyloric antrum on the assumption that the antrum is a

factor in promoting secretion from the acid cells of the fundus. I believe the exclusion operation should be included in the list of useful procedures for hæmorrhagic duodenal ulcer.


The most thorough treatment for hæmorrhagic duodenal ulcer is partial duodenectomy combined with gastric resection. Such a procedure satisfies best the requirements for good ultimate results in that it removes the vulnerable portion of the duodenum and brings about such a profound change in gastric physiology that those factors, mechanical and chemical, which were chiefly responsible for the ulceration, are more or less completely and permanently controlled. In this respect the operation is not equalled by any other procedure. The operation, however, has the very unfortunate disadvantage of being of much greater risk than any of the other procedures, a disadvantage made greater by the fact that the conservative procedures will bring about the same results in a high percentage of cases. I am convinced, however, that since partial duodenectomy combined with gastric resection reduces to a minimum the recurrence of ulceration, it should be employed when it can be performed without greater risk than that entailed by more conservative measures. It requires experience, judgement and a reasonably accessible duodenum. The method of restoring continuity will vary with the condition of the duodenal stump. The Billroth number one operation, I believe, is preferable when it is feasible; in some cases it should be performed after the method of Finney and von Haberer. In cases in which such anastomosis is impracticable, anastomosis of the fundus and jejunum by one of the many methods is indicated. It is true that such an operation does not absolutely insure against recurrence. In cases in which recurrent bleeding jejunal ulcers follow gastric resection for hæmorrhagic duodenal ulcer, recurrence apparently may be partly attributed to too little resection. A very useful surgical procedure for recurrence which takes place under these circumstances is resection of the jejunum, end-to-end jejuno-jejunosomy, resection of the stomach again, and reimplantation of the stomach into the second portion of the duodenum.

Finally, in the surgical management of duodenal ulcer, no more difficult problem confronts the surgeon than in those cases in which jejunal ulcer has followed gastro-enterostomy for duodenal ulcer. The management of the jejunal ulcer is simple, for it is the only type of peptic ulcer in which cure can be obtained in 100% of the cases, namely, by disconnecting the jejunum and the stomach. The question of what should be done with the primary lesion in the duodenum, however, at times is puzzling. In some cases the lesion has so completely healed, without deformity, that no surgical procedure is necessary. In the majority, however, it is desirable to carry out some surgical treatment for the lesion. The safest method is excision of the lesion and reconstruction of the pyloric outlet, which has the advantage, as I have pointed out, of restoring gastro-intestinal continuity in such a way as not to render difficult any later surgical procedure. The most



frequently applicable operation, however, is partial gastrectomy in such cases, with restoration of continuity by the Billroth number one technique if possible, because of the fact that increased vulnerability of the jejunum already has been in evidence.

The results of the surgical management of duodenal ulcer can be predicted with fair accuracy in the individual case, and by adoption of the general principles outlined will parallel those reported by Walton and other British surgeons, namely, that between 85% and 90% of patients who have chronic duodenal ulcer can be assured permanent control of the disease and its symptoms and complications; but it cannot be too strongly emphasized that such results can be attained only by most careful selection both of patients and of operation.



## SURGICAL TREATMENT OF DUODENAL ULCER.

By H. B. DEVINE,

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WHEN a duodenal ulcer has been definitely demonstrated by X rays and the matter of its treatment arises, I am nowadays confronted with three questions in regard to the surgical treatment of duodenal ulcer: (i) Do I think that what we might call "improved medical treatment" will cure a duodenal ulcer? (ii) If it will not, then would gastro-enterostomy cure it—an operation which is not very dangerous or mutilating? (iii) If gastro-enterostomy will not cure it, what operation will cure it, or will any operation cure it?

Once I had no doubt about what should be the surgical treatment of duodenal ulcer. If, at operation, I could demonstrate a duodenal ulcer, I did a gastro-enterostomy. Gastro-enterostomy was, at that time, thought to be one of the most successful operations in surgery. As time elapsed, and I accumulated personal experiences, I became dissatisfied with the results of gastro-enterostomy. Its results were uncertain: at one time it gave a brilliant result, at another, for no cause that was obvious, a failure.

Some patients would tell me that their ulcer pain had gone, but that, after every meal, they had such bad "sinking sensations" and such awful sickness that life was unbearable; indeed, one man threatened to shoot himself if I would not undo his gastro-enterostomy, yet this man had no pain whatever. Other patients would say that they had been well for some years, and that then all their old ulcer pains had returned—obviously jejunal ulcer had formed, or the old ulcer had recurred.

In 1925 I reviewed my experiences in the surgical treatment of duodenal ulcer, and I came to the following conclusions: (i) That there was a type of duodenal ulcer which gastro-enterostomy would not cure. (ii) That some of the patients who were cured of their ulcer suffered more by a by-effect of the gastro-enterostomy than they did from the ulcer for which it was done. That is, they suffered from "sinking sensations", nausea, sickness and vomiting after meals—disturbances of the motor functions of the stomach and jejunum.

However, we need not consider this latter aspect of the failure of gastro-enterostomy as a treatment of duodenal ulcer, except to note that, as an operation, it is very susceptible to even slight errors in technique.

Table I shows rather a broad generalization made from my review of the efficacy of gastro-enterostomy as a treatment of duodenal ulcer.

TABLE I.

Class A.	Class B.
<i>Gastro-enterostomy was successful.</i>	<i>Gastro-enterostomy had failed: pain had recurred: that is, the original ulcer had recurred, or a new one (jejunal ulcer) had formed.</i>
(a) The ulcer was small, on the anterior wall, and not very chronic.	(a) The ulcer was large, often on the posterior wall, spreading widely and excavating into other organs: it frequently showed great evidence of chronicity, as seen by fibrous contracting walls—a "vicious" type of ulcer.
(b) Gastric acidity was not much above normal, or was normal.	(b) Gastric acidity in most cases was very high.
(c) Emptying time was not very rapid.	(c) Emptying time was rapid.
(d) There was generally a previous history of an infective focus.	(d) There was no previous history of any infective focus.
In this type of ulcer, I surmised that infection, causing an acute ulcer, was probably the primary factor; and gastric acidity, making an acute into a chronic ulcer, was the secondary factor. Thus, in this type of ulcer I supposed that the original cause was infective: that the patient had not a duodenal ulcer diathesis; and that the original infective cause might or might not have cleared up.	In this kind of ulcer, I thought that probably the corrosive action of high acidity was the only factor; that the ulcer was, therefore, formed solely on an acidic basis—in the presence of a duodenal ulcer diathesis; and that the original cause of the ulcer was still present.

From these observations, it would appear that, as gastro-enterostomy does not as a rule materially reduce acidity, it could not cure the "acidic" type of ulcer (B), which was initiated and perpetuated by a permanently high acidity—the result of an "ulcer diathesis", a constitutional tendency. In the case of this "acidic" type of ulcer, gastro-enterostomy was very frequently followed by jejunal ulcer. If this jejunal ulcer was resected, it recurred and kept on recurring after repeated resections; and even if a limited partial gastrectomy was done, it again reformed.

In all cases it was found that the operations had not reduced the acidity, and that the jejunal ulcer had formed in the presence of high acidity, and was situated where the acid gastric stream impinged on the jejunal loop, all evidence pointing to the acidic basis of the jejunal ulcer and, therefore, to the acidic basis of the original duodenal ulcer.

On the other hand, the "infective" type of duodenal ulcer (A), although chronic, was much more benign. It seemed to partake somewhat of the nature of chronic ulcer of the leg, and for this reason to be much more amenable to the influence of gastro-enterostomy; it healed readily, as a result of the slight reduction of acidity, and the removal of irritation brought about by the short circuiting action of the gastro-enterostomy. Moreover, as the acidity was not abnormally high, jejunal ulcer did not form.

Looking at these results, one feels that the causation of chronic duodenal ulcer is not clear, or, at least, that the dominant factor of

causations seems to be different in different cases; and that, therefore, the aetiological principles on which surgical treatment must necessarily be based are not clearly defined. My own notions with regard to the causation of duodenal ulcer, notions which I have derived from my clinical experience, and which serve me as a "working hypothesis", are represented in Table II.

TABLE II.

Class A. The "infective" type of ulcer.	Class B. The "acidic" type of ulcer.
Loss of vitality of the duodenal wall the primary factor.	Corrosive action of excessive acidity the primary factor. Vitality of the duodenal wall is normal.
<p>An inadequate circulation, or the effect of a toxin or of bacterial infection lessens the vitality of duodenal wall, the normal vitality of which, let us say, = <math>F</math>, <math>A</math> equalling normal acidity, then:</p> <p><math>\frac{1}{2}F + A</math> = Acute ulcer (loss of vitality of gastric wall is the dominant factor).</p> <p><math>\frac{1}{2}F + (A + \frac{1}{2})</math> = A set of conditions in which the acute ulcer, first formed, is transformed into a chronic ulcer (loss of vitality and increased acidity are equal factors).</p>	<p><math>F \div (A + 2)</math> = Chronic ulcer from corrosive action of acid (excessive acidity is the whole factor).</p>

If we turn now to the various theories of the causation of chronic duodenal ulcer, our views with regard to principles of treatment become somewhat more confused. There are at least three well-defined schools of thought. (i) The first is the school which regards chronic ulcer as originating from acute infective ulcer, the chronicity being caused by acidic irritation, which is regarded as a secondary but vital consideration. (ii) The second is the school which is influenced by the teaching of Aschoff. Its adherents think that ulcer arises from the direct corrosive action of excessive acidity on the mucous membrane, and that the ulcer is chronic from a small pin-point beginning. (iii) Members of the third school base their beliefs on the more modern theory of Konjetzy, namely, that ulcer arises on the basis of chronic follicular gastritis.

All these hypotheses must obviously involve quite different principles in regard to surgical treatment, and, as a result of this, the various aetiological views are reflected in the diverse methods of treatment.

On the Continent in 1922 gastro-enterostomy was the operation of choice for the treatment of duodenal ulcer. In 1932 gastro-enterostomy had been almost entirely abandoned for partial duodenectomy combined with partial gastrectomy, because its results were so unsatisfactory; and it is now performed in only 10% of cases. In English-speaking countries gastro-enterostomy is the operation of choice in 80% of cases. I believe that it is not scientific for us to think that the Continental surgeons are wrong, and we are right. I believe that Aschoff's

observations made on Continental material are correct; that the type of ulcer usually seen on the Continent is caused mainly by acidity; that it is the same as my "acidic" type of ulcer; that it is the exceptional type of duodenal ulcer in this country; that gastro-enterostomy, which cannot materially reduce acidity, cannot cure it; that medical treatment cannot possibly cure it; and, finally, that only an operation which will effectively reduce acidity, such as an adequate partial gastric exclusion, or partial gastrectomy, will cure it. I am not sure that the high percentage of gastro-enterostomy cures in our country is not due to the fact that it has been unnecessarily applied to ulcers in the infective end of the scale, and I am doubtful whether a great number of these ulcers would not be less dangerously and just as effectively dealt with by medical treatment. I feel, however, that the more chronic ulcer of this kind probably could not be cured without a gastro-enterostomy.

In 1925, not satisfied with the results of gastro-enterostomy, and realizing that it would not cure this chronic "acidic" type of ulcer, I tried the effect of removing the ulcer from the action of acidity by performing a pyloric exclusion. The duodenal ulcer healed, but the whole "blast" of the highly acid gastric stream, playing on the jejunal mucous membrane, which is naturally less resistant to the action of acid than that of the duodenal mucous membrane, caused the most virulent type of jejunal ulcer. I then endeavoured to reduce the acidity by excluding half the stomach. In a few of these cases the patients developed jejunal ulcer, but the rest were most satisfactory.

It was not, however, until I excluded two-thirds of the stomach and thus excluded a large part of the acid-bearing mucous membrane that I was able to cure this type of ulcer without producing a jejunal ulcer.

Since 1928 I have done a number of extensive gastric exclusion operations, and the patients are very well.

In my later cases I found it convenient to reduce redundancy of the excluded distal two-thirds of the stomach by resecting most of it (Figures II and III). I have, however, always regarded the preservation of a reasonable amount of the pyloric part of the stomach as an important principle of the operation, for this reason: that, if a jejunal ulcer forms, it is easily dealt with by reuniting the segments of the stomach, whereas, if a partial gastrectomy has been done, the occurrence of jejunal ulcer presents a dangerous surgical problem.

The preservation of the pyloric part of the stomach has, in my experience, not been a factor in causing, by any hormone action, increased acidity. In any case in which the acidity had not been sufficiently reduced, I always found that I had not excluded (or resected) enough of the stomach.

In a further attempt to minimize the occurrence of jejunal ulcer, I employed a loose short post-colic jejunal loop in making the gastro-anastomosis. I felt that the mucous membrane in the short jejunal loop would be more resistant to action of acid than that in the long loop. The looseness of the loop enables the efferent limb to be disposed trans-

versely, so as to avoid the vertical position, which predisposes to jejunal ulcer by presenting an opposing surface, as the anterior duodenal wall



FIGURE I. Extensive gastric exclusion, two-thirds of the stomach being excluded. The excluded part makes really a prolonged duodenum.

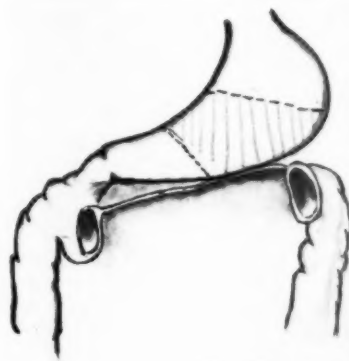


FIGURE II. Diagram to show the amount of stomach removed, where a resection of part of the acid-bearing area is combined with exclusion.



FIGURE III. The operation of exclusion and resection, in which a short loose retrocolic loop is used, the duodeno-jejunal flexure being transposed into the lesser peritoneal cavity, and only the efferent loop being stitched into the opening of the meso-colon.



FIGURE IV. Exclusion with resection, a short loop being used as in Figure III, but the anastomosis being made after the manner of the Billroth II operation.

does to the "gastric stream". This short post-colic loop was obtained by transposing the duodeno-jejunal flexure to the lesser peritoneal cavity as in Figure IV.

Therefore, in my opinion, the operation of choice in these severe "acidic" types of duodenal ulcer are the operations illustrated in Figures II, III and IV. Their immediate mortality is no higher than that of gastro-enterostomy.

As failure to cure the ulcer by gastro-enterostomy may be due to a faulty operation, I must specially emphasize the fact that, if a gastro-enterostomy is to be successful, it is necessary to adhere to certain essential principles which, my experience in gastric surgery tells me, govern its success. Gastro-enterostomy depends for its curative effect on: (i) drainage of the stomach, (ii) reduction of acidity as a result of regurgitation of duodenal contents. Drainage depends on: (i) the position of the stoma—the nearer the stoma is to the cardia, the more rapid the emptying time; (ii) the size of the stoma; (iii) the tone of the gastric muscle (estimated at X ray examination); (iv) the absence of kinks in afferent and efferent loops.

If the emptying time be too rapid, the gastro-enterostomy will be a failure; if it be too slow, it will also be unsatisfactory. Regurgitation of duodenal contents and, therefore, reduction of acidity, are best accomplished by directing the contents of the afferent loop into the stomach. Practically all these desiderata are attained by removing the vessels from the most dependent part of the lesser curve, and by making the opening into the intestine correspond with the greater curvature.

Gastro-enterostomy I regard as an expedient operation, to be used only when the tonic condition of the patient's gastro-intestinal musculature is suitable, and when the type of ulcer and the associated physiological condition are appropriate; never to be employed on young people, for I believe it is only a question of time before jejunal ulcer will form; to be used in the case of the "acidic" type of duodenal ulcer only in the old and feeble. Furthermore, I should like to say, in regard to gastro-enterostomy as a treatment of duodenal ulcer, that, after the experience gained in undoing about fifty gastro-enterostomies, I am of the opinion that it is an exceedingly difficult operation to perform properly. I believe that it is susceptible to the slightest errors in technique, for which the patient pays a high price in misery. I feel that the principles on which it is based are so indefinite that it is difficult to apply and to perform properly. Nevertheless, a great many gastro-enterostomies give, in my experience, brilliant results.

Recently I "followed up" some of the very bad cases of duodenal ulcer for which I had done an extensive gastric exclusion, and I was surprised to find how good and how lasting the curative effect of the operation had been.

Thus, in answer to the three questions which at the beginning of this paper I put forward, I would say:

1. I am more inclined to rely on medical treatment for chronic ulcer of the "infective" type. I do gastro-enterostomy for this kind of ulcer far less often now than I used to.

2. I employ gastro-enterostomy for the very chronic ulcer, which I think may have originated on an infective base—an ulcer with an

associated acidity that is not too high. When I do use a gastro-enterostomy, I pay great attention to the operative details, which I modify according to the physiological circumstances present in the particular stomach to which it is being applied.

3. In the "acidic" type of ulcer I feel sure that a gastric exclusion, with an adequate gastric resection, will permanently cure the most intractable type of duodenal ulcer without giving rise to jejunal ulcer. I cannot make myself perform duodenectomy and partial gastrectomy for the cure of duodenal ulcer, as is done on the Continent. From experience, I know that the danger of removing a penetrating and callous duodenal ulcer is great, and, moreover, not justified in an innocent affection. Furthermore, a train of unpleasant gastric symptoms, due to the supervention of chronic gastritis, sometimes develops in these "gastrectomized" cases.

In conclusion, may I prophesy that it will not be long before the physician will be able to handle that imbalance of the vegetative nervous system which, I feel sure, lays the basis of the pathological physiological conditions that beget chronic duodenal ulcer. Then shall we be done with some of what I regard as the rather unscientific, but, in the present state of our knowledge, very necessary, operations.

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## FAILURE AFTER GASTRO-JEJUNOSTOMY.<sup>1</sup>

By HUGH R. G. POATE,  
*Sydney.*

As a contribution to the discussion so ably opened this evening by Dr. Balfour, I have been invited to deal with the inglorious problem of "failure" in the surgical treatment of duodenal ulcer.

I thought one of our physician colleagues would have been better qualified to deal with this aspect than I, as one frequently hears it said that it is the physicians and not the surgeons who see and treat the failures. However, we all know that there is an uncertain number of patients who do not receive the expected benefit from operation.

Before we can discuss failures I think we must postulate some definite criterion of cure in these cases, looking at it from the patient's point of view, and I would submit the following standard for your consideration:

1. Following upon a period of convalescence of not more than four months from the date of operation the patient must be free of all symptoms or signs attributable to ulcer.
2. For a minimum period of three years he must be able to indulge in a relatively liberal diet without suffering from any dyspepsia other than occasional slight indigestion due to acknowledged indiscretion.
3. He must have resumed and been able to carry on some usual vocation in life.

It is not my intention to quote statistics, as these are available to all of us, but I think that if you go through the figures you will find that approximately two-thirds of the patients operated on may be classed as cured. Of the remaining third we have a small number who are unsatisfactory in some respect or other, because of factors which are beyond the control of either themselves or their medical advisers.

Surgeons have been held to have performed gastro-jejunostomy on patients with tabes, pregnancy, Banti's disease, alcoholic gastritis, and various other conditions, but I feel sure that no reputable surgeon of even slight experience would be guilty of performing a gastro-jejunostomy in the absence of a definite chronic ulcer. I myself have operated on a tabetic for a chronic duodenal ulcer, but it was known first that he was a tabetic. I have had female patients subsequently become pregnant and be referred to me for an explanation of the vomiting! In one case a patient developed Banti's disease and exhibited a gastro-

<sup>1</sup>Read at the annual meeting of the Royal Australasian College of Surgeons, Melbourne, on March 5, 1935.

staxis some years after operation. The worst factor with which we have to contend in returned soldier patients operated on for chronic ulcer is the question of an alcoholic *plus* tobacco habit.

Of the uncontrollable factors I would particularly instance those few folk whom I have seen who have a definite ulcer diathesis and who will keep on forming new ulcers, no matter what is done for them. I should like to instance one man who has been under strict supervision for seventeen years, during which time he has had seven operations, five of which were performed by me for conditions of urgency. Again, I have several patients who now and then have a hæmorrhage, although otherwise well, and X ray examination reveals no organic lesion. Again, others exhibit persistent hyperchlorhydria, despite the most strict régime, and some go to the other extreme and develop achlorhydria.

Putting aside these few unaccountables, we may turn to the preventible failures. Some of them must be placed to the discredit of surgeons, and others to the neglect of patients to follow a normal post-operative régime as outlined by the medical attendant. Time will not permit me to delve into the subject at length, so I shall merely detail the causes of failure in each instance.

#### FAILURE ON THE PART OF THE SURGEON.

On the part of the surgeon we may classify the factors influencing failure into two groups: improper selection of cases, and errors in technique.

With regard to the former it seems generally agreed that no recent and hitherto untreated ulcer should be operated upon. Preliminary treatment should include the elimination of septic foci in the nasal and oral cavities along with strict adherence to a definite régime of diet and alkalinization for a period of six months.

Fat people are as a rule unsuitable subjects as they usually have a short meso-colon and a high unyielding stomach, rendering a satisfactory gastro-jejunostomy a very difficult technical procedure. In addition, these fat subjects usually have a high degree of hyperchlorhydria, thickened gastric mucosa and hypertrophic musculature in the gastric wall. I always view with misgiving those of the plethoric type with a raised blood pressure, as they too usually have the sthenic type of stomach.

The omission to recognize and, where possible, to deal with coexisting chronic disease in other viscera is a not uncommon cause of unsatisfactory results, and in particular I would mention chronic duodenal ileus with or without a generalized visceroptosis. It is not sufficiently recognized that chronic duodenal ileus often occurs independently of any visceroptosis. The most extreme cases that I have seen were secondary to adhesions after a suppurative appendicitis. Of chronic infective lesions, disease of the gall-bladder and appendix are the most common and both these organs should be examined in all

cases. One of the most troublesome and annoying of possible coexistent diseases is a chronic colitis, and patients with this complaint are unfavourable for operation unless some emergency compels it.

As to errors in technique, there are many possibilities, such as placing the stoma too high up on the stomach or too near the lesser curvature, making it too narrow, whereby its objective is not attained, or too wide, when diarrhoea is apt to follow from the irritation of food which has had no chance of gastric digestion. Again too long a loop of jejunum may be left or even too short a loop, which is one of the most common causes of chronic vomiting at intervals of days or weeks as a result of obstruction of the afferent limb of the jejunum. Of course we all are aware of the danger of not suturing the meso-colon to the stomach and of inadvertently suturing together the anterior and posterior edges of the stoma, but I feel that many surgeons err in taking too wide a bite of the jejunum in their stitches, which leads to a taut stretching of the mesenteric portion of the jejunum across the stoma, or produces an actual spur. Other forms of operation than gastro-jejunostomy are available in certain cases and the surgeon must be *au fait* with these and select the one requisite for the patient under consideration.

I have left to last the question of suture material and so impressed have I been with the liability to the formation of jejunal ulcer following the use of non-absorbable suture material that for many years I have used nothing but number one plain catgut in a three-layer technique.

#### FAULTS ON THE PART OF THE PATIENT.

Of the patient's faults I would place first of all the non-observance of a modified post-operative diet for a minimum period of six months and the free use of alkalis for three months. Alcohol and tobacco also play important parts, and it is at times amazing to find how mendacious patients are in these respects.

Neurosis, or even malingering, often plays a part, and this is well exemplified in the case of soldier patients who refuse to admit benefit by operation for fear of losing a pension, and in whom all tests and examinations reveal a state of normality.

In conclusion, I would say that improvement in general results lies largely in the hands of our Colleges of Surgeons, who by interchange of ideas, education of our Fellows, example and precept, can largely eliminate the faults which I have enumerated as being the liability of the surgeon.

## MODIFICATIONS OF SURGICAL PROCEDURE IN CASES OF CATARACT COMPLICATED BY ECONOMIC FACTORS AND BY GENERAL CONSTITUTIONAL DISEASE.

By GUY A. POCKLEY,  
*Sydney.*

CATARACT is a disease chiefly of middle and late life. Surgical treatment of cataract by extracting the lens through a limbal incision was first practised by Daviel in the year 1745. Since this time this method has been universally used, though technical modifications of the surgical procedure have been innumerable.

At the present moment there are a great number of different surgical modifications in vogue. Some surgeons use one method, some another, as their operation of choice in routine work, and no doubt in the great majority of cases an equally good average of successful results is obtained.

However, though different techniques in the hands of different surgeons give very similar results as regards success, there is no doubt that some types of cataracts give better prospects of success with one surgical technique than with another. For this reason no surgeon can afford to adopt a routine method of operation for all cases, and the most efficient surgeon is one capable of varying his technique according to the requirements of any particular case.

The object of this paper is to stimulate a discussion and an interchange of ideas amongst those ophthalmologists present, and to be a basis for an interchange of opinions formed by different ophthalmologists as a result of their own experience in dealing with various complicating factors, no matter what each man's standard routine method of extracting cataracts may be.

I propose to give my own methods and modifications of technique as practised when complicating factors are present, and to mention the ideas that I have at the present time with regard to the surgical treatment of cases complicated by general constitutional disease and by economic factors. Such ideas are based on the successes and failures which have occurred during a quarter of a century of active surgical life. I feel that there are vast scotomata in our knowledge, and that we are still a long way from being able to realize the ideal of securing 100% successes. Probably this ideal will never be realized, but an active interchange of opinions at a meeting such as this is much more valuable

than the reading of any set paper. So this paper has designedly been made brief, and it is hoped that it will prove provocative of a free discussion and argument on debatable points.

#### ENUMERATION OF METHODS.

I propose to enumerate briefly the various methods that I use in my own practice, with a few comments on them, and to follow this with some remarks on general constitutional disease and economic conditions complicating surgical treatment.

My standard operation for uncomplicated cases of senile cataract is the combined operation of extraction with iridectomy. This is done without previous mydriasis, with the result that the small biconcave iridectomy is no more productive of glare or visual confusion than is simple extraction or extraction with late peripheral iridectomy. Simple extraction and extraction with late peripheral iridectomy have been practically discarded as a routine, as results have not proved so safely productive of good results as the combined method.

Prolapses and incarceration of the iris were found to occur in too great a percentage of cases. The union of a cataract incision almost certainly is broken down on more than one occasion before final healing occurs, and each breaking down of union is liable to be accompanied by a gush of aqueous which may lead to this complication.

Again, when one operates on cataracts which are immature, it is not always possible to extract all cortical matter completely, and more needlings are required. While I do not suggest that an "after-cataract" is necessarily a serious complication, there is no doubt that convalescence is prolonged, and there is greater tendency to iritis, leading in some cases to a less satisfactory result.

Intracapsular extraction has been tried by many methods, but has been abandoned entirely, as loss of vitreous occurs too frequently. Loss of vitreous again is not necessarily fatal to the eye, but I think all will agree that it must be regarded as a very serious accident.

In the combined operation, loss of vitreous occurs in considerably less than 1% of cases, while the most ardent advocates of intracapsular extraction admit to loss of vitreous in up to 10% of cases.

Dislocation and extraction of the lens by suction cups have never been attempted.

Extraction after preliminary iridectomy is frequently adopted, and perhaps it would be as well to discuss first of all preliminary iridectomy.

I have classified preliminary iridectomy as follows: (i) simple preliminary iridectomy, (ii) preliminary iridectomy (optical), (iii) preliminary iridectomy (snip and tear), (iv) preliminary iridectomy with maturation.

*Simple Preliminary Iridectomy.*—Simple preliminary iridectomy is made use of in many cases in which, owing to senility, doubt as to the mental stability of the patient, constitutional diseases, such as diabetes, severe bronchitis *et cetera*, make it advisable to test the patient's

powers of healing and powers of submission to the necessary discipline of after-treatment, when one feels that a calamity might follow a straight out cataract extraction.

*Preliminary Iridectomy (Optical).*—Preliminary iridectomy is used in cases in which there is a small central cataract that causes serious obstruction only when the pupil is small. I have found the routine instillation of mydriatics, as largely practised by certain charlatans (though very impressive to the patient), to be frequently followed by incurable blindness from chronic glaucoma. In my own practice I must have had at least fifty patients during the last twenty-five years completely blinded by one unqualified person using mydriatics for this purpose.

A preliminary iridectomy has the effect of safely enlarging the pupil, and in many cases will enable the patient to carry on his occupation for years without submitting to the major operation of extraction of the lens.

*Preliminary Iridectomy (Snip and Tear).*—Preliminary iridectomy is practised in those cases in which there is a secondary rise of tension associated with the cataractous changes in the lens. This appears frequently to be due to a swelling of the lens associated with a rapidly forming cataract. It is also quite common in cases of diabetic cataract, and I have frequently found after extraction of a lens, following on a preliminary snip and tear iridectomy, that arteriosclerotic hæmorrhages are present in the retina, and sometimes thromboses of the retinal veins.

Thrombosis of retinal veins, as we know, is a frequent cause of intractable glaucoma. As an opaque lens precludes an ophthalmoscopic examination, a preliminary snip and tear iridectomy will occasionally be the means of saving an eye from an expulsive hæmorrhage, which no doubt would occur if an extraction were done outright.

In most cases of raised intraocular tension associated with cataract a small snip and tear iridectomy through a keratome incision made well back in the angle, will suffice to keep the tension normal for a month or two at least, and within this time one can safely extract the lens by a second operation. Should the tension not fall after a preliminary snip and tear iridectomy, it is probable that there are thromboses of the retinal veins, or that other more grave trouble is present.

In one case tension was not relieved at all by the iridectomy; in fact, it remained so high and increased so much that one was frightened to perform an extraction. When a painful blind eye was removed at a later date, chorioidal sarcoma was discovered to be the cause of the tension.

Incidentally, I do not know whether it is commonly known, but unless a cataract is very much a "black" cataract, transillumination will be found to give just as reliable results in the presence of a completely opaque lens as when the lens is clear.

On three occasions in my personal practice I have accurately diagnosed sarcoma of the chorioid when the tension was slightly raised

and the lens was completely cataractous. So in these cases I was prevented from making the mistake of doing even a preliminary iridectomy.

*Preliminary Iridectomy with Maturation.*—The technique of preliminary iridectomy with maturation has been thoroughly reported on more than one occasion during the last fifteen years, so it is not proposed to deal with it exhaustively here. I cannot, however, refrain from reiterating that the absolute essential for safe and successful maturation is to make sure that the whole of the aqueous is out of the posterior chamber and retrolental space, as well as out of the anterior chamber, before any attempt at massage is made.

I have seen a surgeon dislocate a lens through failure to do this effectively; and in all cases in which satisfactory maturation does not occur this is certainly the reason.

For satisfactory extraction it is essential that the posterior cortex be completely opaque. If the posterior cortex is opaque, extraction will readily be carried out; if it is clear and viscous, the lens can very seldom be safely and completely extracted after capsulotomy.

*Extraction with a Very Large Conjunctival Flap.*—Extraction with a very large conjunctival flap has been advocated during recent years, and has been tried after completion of the flap with and without suturing, and also by use of a flap when the conjunctiva is not completely cut through. The latter is the method selected when it is thought necessary or desirable to do this operation.

At first sight this operation will appear to have all the advantages of added safety, and none of the disadvantages of the ordinary operation. However, after a series of fifty consecutive cases I discarded it, except in rare instances, but within the last two years I tried it in another series of a hundred consecutive cases. I now use it in only a small percentage of cases for the following reasons: (i) It is invaluable when one feels sure that the patient will not stay in bed, or cannot be kept in bed with safety after operation; for instance, in patients with too little mental stability to submit to surgical discipline. (ii) It can be done after preliminary iridectomy as easily as without preliminary iridectomy, if a patient proves intractable with the simple operation of preliminary iridectomy. (iii) Again, in dealing with patients suffering from chronic bronchitic conditions, when it is not possible or not safe to suppress the cough with drugs, this method is invaluable, as the patient can be sat upright immediately.

However, my reason for having discarded it as a routine procedure is that it was found that the average stay of the patient in hospital after this operation was five to six weeks instead of the ten to fourteen days that are customary with the combined operation. The reason for this is that in many cases large masses of blood accumulate in the anterior chamber. The eye may look perfectly clear for from forty-eight hours to three or four days after operation, but I have been alarmed



to find the anterior chamber more or less filled with blood at a subsequent dressing.

Persistent observation disclosed the following reason. In the process of healing, the scleral wound is broken down on probably more than one occasion as the aqueous reforms and the intraocular tension rises to normal; usually in the centre of the incision a gush of aqueous escapes. After this operation it cannot escape freely, but is caught under the flap of conjunctiva. Between the conjunctival flap and the sclera new blood vessels are in process of formation. Haemorrhage occurs from these vessels when they are torn across, and the blood enters the anterior chamber from the scleral wound. Most of the extravasated blood absorbs without damage to the eye, but the visual results after these massive haemorrhages have proved to be not so satisfactory as those obtained with the combined method, and at best convalescence is very greatly prolonged.

So much for the methods that I use in my own practice for cataract extraction.

#### SELECTION OF TIME FOR OPERATION.

With regard to the time selected for operation, in the dark ages it was customary to wait for complete maturity of the cataract before extracting the lens. The economic exigencies of modern life make it essential in many cases to operate on cataract in various stages of immaturity.

If any standards are to be laid down, I would suggest that in dealing with all patients who are constitutionally fit, it is in the patient's interest that he should have an extraction performed before the stage is reached at which he cannot see to feed himself unaided. Where economic urgency is greater, for instance in the case of a man who is dependent on sufficient vision to read newsprint for his livelihood, when the visual acuity is, say,  $\frac{6}{18}$  partly or less, operation can safely be performed by using the method of preliminary iridectomy and maturation, followed by the operation of extraction.

In some cases one can almost as safely extract the unripe cataract by the ordinary combined operation; for instance, in the seventh decade of life or later probably sufficient of the lens can be extracted without undue trauma and without the necessity for maturation.

At earlier ages one finds that the lens can be satisfactorily extracted, provided the posterior cortex is opaque; but it cannot be extracted satisfactorily if the cortex is not opaque. In earlier life, or when the posterior cortex is not opaque, the operation of preliminary iridectomy and maturation following by extraction has been found not only to give better results than are obtained when the extraction is done outright, but to give better average results than extraction of mature cataract, the latter probably because operation is performed when the patient is younger and more fitted both physically and mentally to recover from an operation.



By means of this operation one can be confident of securing a complete maturation in one month, or even in less time.

#### THE PHYSICAL AND MENTAL CONDITION OF THE PATIENT.

In assessing the relative value of actual surgical treatment in the theatre, and the after-treatment, it would probably be reasonable to say they were at least equally important. Cataract being a disease of the aged, we have been frequently faced with the problem of operating on people who are decrepit both physically and mentally.

Vascular degeneration is always a source of danger. When I was discussing with the late Dr. Shorney, of Adelaide, the treatment of a cataractous patient suffering from high blood pressure, he informed me that he always performed the ancient operation of bleeding the day before, and always obtained beneficial results.

My own practice has been to put the patient to bed for three or four days before operation, and the rest with modified diet usually suffices. After operation, care is taken not to allow the patient to lie flat in bed; and the process of getting up from bed is carried out very slowly and very carefully.

Mental degeneration is very often closely associated with vascular degeneration, and may take the form of incapacity to remember instructions and general inability to submit to surgical discipline, and even of acute post-operative mania. Environment has been found to influence this considerably, and when uncertainty is felt about the patient's post-operative behaviour it is wise to have him for some days prior to operation in the bedroom that he is to occupy after operation. A special nurse, preferably one known to the patient, or one who has been attending him for several days prior to operation, is invaluable.

Alcohol has been found very valuable in the control of post-operative mania. Whether the mania in these cases has any association with *delirium tremens* it is hard to say, but my routine practice, when alcohol is not contraindicated for any special reason, is to give the patient some alcohol every evening in addition to any hypnotic or sedative that may be used.

In all cases in which mental instability is suspected a preliminary iridectomy is performed as a routine measure, and, if the patient proves at all uncontrollable after this minor operation, extraction under an uncompleted conjunctival flap is carried out.

#### COMPLICATING CONDITIONS.

*Pulmonary Conditions.*—Very aged patients in whom hypostatic pneumonia may occur should be placed in bed in a fairly erect sitting position, and movements must not be unduly restricted.

*Prostatic Disease.*—In dealing with patients suffering from prostatic obstruction preliminary practice in the use of the urinal in bed is very necessary, as many patients will be found to need catheterization if they are asked to pass urine in bed for the first time after a cataract

operation. Personally I prefer to let the patient sit on the side of the bed supported by a nurse, rather than resort to catheterization in such cases.

*Myxœdema.*—I have the impression that myxœdema is a somewhat deceptive condition. The eye usually remains very white and quiet for many days after operation, but I have observed a tendency to late, chronic, mild iridocyclitis. I have tried the use of thyreoid extract before operation, but by so doing have not entirely prevented these later quiet inflammations from occurring.

*Diabetes.*—Prior to the discovery of insulin, diabetics were always considered an extremely bad surgical risk. Grave hæmorrhages were liable to occur as a direct result of the operation, and patients were known to lapse into a state of coma at about the time when one was contemplating getting them out of bed. Many cataracts in advanced diabetics were regarded as inoperable.

Since the discovery of insulin, a diabetic patient can be approached with practically the same confidence as a normal patient, provided that prior to operation he is given a free carbohydrate diet with the use of the necessary amount of insulin. My practice is to have a diabetic patient in hospital for about three weeks prior to operation, where in collaboration with a physician this is done.

Another essential is that immediately after operation, when the patient's diet is necessarily very much reduced (the usual practice being to give only small quantities of liquid through a feeding cup), the doses of insulin must be cut down very materially; otherwise the patient will become excitable and uncontrollable.

My practice is always to do a preliminary iridectomy in these cases, followed at a later date by extraction without a conjunctival flap.

Of course, though diabetic patients may stand operative treatment well, there is always the danger of visual results being unsatisfactory owing to the existence of old diabetic retinal disease which could not be diagnosed before operation because the cataract prevented ophthalmoscopy.

*Chronic Sepsis.*—I feel that chronic sepsis is one of the most difficult complicating factors in surgical treatment of cataract. Many patients with the most frightful oral sepsis and pyorrhœa are operated on with apparently no detrimental effect to the eye. However, one occasionally finds that a patient develops iridocyclitis which is ultimately traced to an apical abscess of a tooth.

The physical and mental upheaval occasioned in elderly people by extensive extraction of teeth prior to operation makes one question the advisability of having many teeth removed prior to the extraction of the cataract, when a general oral sepsis is present.

Apparently such patients develop considerable immunity to their own particular infection, and remain immune if they are not interfered with. My practice in dealing with the better class of patient is to have an X ray examination made if there are one or two doubtful teeth and,

if an area of apical absorption is found, to have the tooth extracted prior to operation. In the case of the general hospital type of patient with an extensive infection I content myself with cleansing the mouth as far as possible with ordinary mouth washes and a toothbrush for a few days before operation.

*Pyelitis or Bladder Infections.*—Pyelitis or bladder infections should be dealt with as effectively as possible prior to operation, as lying still in bed always seems to aggravate the condition.

*Gall-Bladder Infections.*—Gall-bladder infections must always be regarded seriously. So-called complicated cataract has been found in my experience to be so frequently and closely associated with a pathological gall-bladder that, where I find the faded atrophic iris, the quiet keratic precipitates and the cataractous lens, my first step is always to have Graham's test carried out; and I always feel surprised in the very rare event of the gall-bladder not being found at fault.

Either surgical treatment of a gall-bladder known to be infected should be carried out prior to cataract operation, or, when this is impracticable, a course of immunization against the particular infection (usually a streptococcus) should be carried out.

My experience with so-called complicated cataracts is that they must be approached with trepidation. One frequently sees cases in which there seem to be permanent and non-active precipitates on Descemet's membrane, but operation can be undertaken with reasonable prospects of success even in such cases, but only when, on repeated examinations carried out at intervals over a considerable period, slit-lamp microscopy has failed to disclose any cells in the aqueous.

One could continue for many hours to elaborate on general constitutional pathological conditions, but it is hoped that these necessarily brief impressions will suffice as a basis for a useful discussion on the subject.

I think it was Bacon who said:

Reading maketh a full man,  
Conference maketh a ready man,  
Writing maketh an exact man.

This paper was written as a basis for conference in the hope that such will improve our "readiness" to deal with cataracts under all circumstances.

## POSTURE AND POST-OPERATIVE TREATMENT IN EYE CONDITIONS.

By J. BRUCE HAMILTON,  
*Hobart.*

RECENTLY a famous anatomist whose refraction was being estimated by an equally famous oculist, said: "Doctor, do you consider man's astigmatism the result of his erect posture?" Today I have no intention of leading you through the realms of evolution, but to discuss the subject of posture from quite another aspect.

While acting as house surgeon both in Australian and English ophthalmic hospitals, I was confronted by three facts in the post-operative treatment of eye conditions, and especially of patients with cataract:

1. Patients suffered great discomfort by being nursed in a supine position, without any alteration for seven to ten days. This discomfort manifested itself by extreme pain in the loins and shoulders.
2. This pain in the back invariably led to flatulence and often to vomiting, with consequently disastrous results to the eye that had been operated on in the form of intraocular hæmorrhage and prolapse of the iris.
3. This unnatural position often resulted in congestion of the lungs, retention of urine, mania, and sometimes to sudden death from cardiac failure. This sudden death was due to sudden alteration of the patient's posture resulting in coronary thrombosis.

I therefore suggested to my senior colleagues that Fowler's position should be tried as an alternative in post-operative treatment, but here I met with great opposition from both the medical and nursing professions. Ultimately I was allowed to nurse in the erect posture a few patients whose cataracts had been extracted, and the results were just as I anticipated, that is, post-operative convalescence was free from all complications and discomforts. A dozen patients had been treated thus by me, when I returned to Australia, determined to carry on the experiment with my own patients, so convinced was I that I had arrived at a very definite advance in post-operative treatment.

### TECHNIQUE.

In all conditions except detachment of the retina, my procedure is as follows. When the patients are returned from the theatre, I personally superintend their move from trolley to bed in the supine position. Then they are asked to sit erect very slowly, their heads being

supported with my hand. Thirdly, they are bodily lifted towards the head of the bed about twelve inches and seated on an air cushion. Pillows are then piled behind them to keep them in this erect position and a "Fowler's pillow", strapped to the head of the bed, is placed under their knees to prevent them from slipping. At night their hands are lightly tied by clove hitches to the sides of the bed, and an electric bell is placed in one hand. Rest in this posture is assisted by hypnotics (either "Luminal" or "Nembutal") given before and after operation.

In dealing with cases of detachment of the retina, on the other hand, the patient's head is placed in such a position that the retinal hole is in the most dependent portion of the eye, as recommended by Gonin. This practice with detachments is almost universal and needs no comment here. Patients who have been subjected to general anaesthesia are not placed in Fowler's position until full consciousness has returned.

After four years of experimentation with Fowler's position, I think the moment opportune for an analysis of all major conditions treated by me with this method. This analysis must be one of private patients only, for the notes of public hospital patients are not adequate for any analysis.

#### CATARACT.

First, let me discuss the cataract extractions for which this alteration in posture was first advocated. These number 61 in all, namely, 49 combined extractions and 12 attempted intracapsular extractions.

There was one sudden death, that of an elderly woman with myocarditis and a systolic blood pressure of 230 millimetres of mercury. This patient was operated on at a public hospital, and a sudden alteration of position caused a coronary thrombosis.

Not one of the patients complained of pain in the back and not one vomited after operation. None developed pneumonia or mania or retention of urine, and only two had a mild post-operative pleurisy. Both patients with pleurisy were debilitated old women who would undoubtedly have developed pneumonia if they had been nursed in the supine position. Further, one of these women had already had a cerebral hæmorrhage. One patient with a previous thrombosis of the leg developed an enlargement of clot when put in Fowler's position.

There was one prolapse of iris and that in my first intracapsular extraction. This was entirely due to the fact that I neglected to instil eserine after the extraction. There were two cases of small post-operative hyphæmia, but neither was of any consequence. Table I gives an analysis of these facts.

#### NEEDLING AND CAPSULOTOMY.

Next let me analyse the needling and capsulotomy cases, which number 20 and 26 respectively. Not one of the patients in these groups developed pain in the back, mania, pneumonia, pleurisy, thrombosis of the leg, retention of urine or post-operative hyphæmia, despite the fact

that a number of the operations were performed under general anaesthesia. This is again demonstrated in Table I.

TABLE I.

Condition.	Cataract, 61 Cases.	Needling, 20 Cases.	Capsulotomy, 26 Cases.
Sudden death .. .. .	1	Nil	Nil
Post-operative vomiting .. .. .	Nil	—	—
Pain in back .. .. .	Nil	Nil	Nil
Mania .. .. .	Nil	Nil	Nil
Pneumonia .. .. .	Nil	Nil	Nil
Pleurisy .. .. .	2	Nil	Nil
Post-operative hyphemia .. .. .	2	Nil	Nil
Thrombosis of vein in leg .. .. .	1	Nil	Nil
Retention of urine .. .. .	Nil	Nil	Nil
Prolapse of iris .. .. .	1	—	—

#### GLAUCOMA.

But now let me turn to the glaucoma, in which the position is not so happy. From December 1, 1930, to November 9, 1933, I performed 16 trephines and nursed all the patients in Fowler's position. The only general complication that arose in these 16 cases was one thrombosis of the right saphenous vein, which caused the patient some pain and kept him in the hospital for two extra weeks. But in five of these 16 cases adequate drainage was not established and, except in one case in which an enormous post-operative hyphemia occurred on the fourth day, there was no definite cause to be found for this lack of drainage. So on October 9, 1933, I discarded Fowler's position for trephine cases and nursed the next 15 patients supine; this brings my cases up to December 31, 1934. Among these 15 operations there were three cases of retrephining and only one drained adequately after the second operation. Of the remaining 12 patients, all but one developed an adequate drainage. I think, therefore, that I have conclusively proved that gravity plays too definite a part in drainage after trephining to permit the patient being nursed in the erect position. All 15 patients complained bitterly of backache, and I have had to turn many of them on their sides to prevent vomiting.

#### OTHER CONDITIONS.

Lastly, let me analyse the cases of squint, excision of the sac, excision of the globe, evisceration of the globe, exenteration of the orbit, prolapse of the iris, and plastic operations. These total 61 in all. Not one patient developed pneumonia or pleurisy, despite the fact that many operations were done under general anaesthesia; nor in any did pain in the back or retention of urine or mania appear. No patient suffered from thrombosis of the leg. Nevertheless, two patients with prolapse of the iris, whose operations were performed under general anaesthesia, developed post-operative hyphemias of serious consequence. Table II exhibits these facts.

TABLE II.

Condition.	Squint, 17 Cases.	Excision of Sac, 15 Cases.	Plastics, 7 Cases.	Prolapse of Iris, 7 Cases.	Excision of Globe, Evis- ceration of Globe, Exen- teration of Orbit, total 17 Cases.
Sudden death .. ..	Nil	Nil	Nil	Nil	Nil
Pain in back .. ..	Nil	Nil	Nil	Nil	Nil
Mania .. ..	Nil	Nil	Nil	Nil	Nil
Pneumonia .. ..	Nil	Nil	Nil	Nil	Nil
Pleurisy .. ..	Nil	Nil	Nil	Nil	Nil
Thrombosis of leg ..	Nil	Nil	Nil	Nil	Nil
Retention of urine ..	Nil	Nil	Nil	Nil	Nil
Post-operative hyphemia	—	—	—	2	—

## CONCLUSION.

I think these results need no further comment from me, for the material gain from Fowler's position in selected cases is obvious. But even if this had not been obvious, the great increase in the patient's physical comfort would be sufficient to warrant my advocacy of this method of post-operative posture. In conclusion I would greatly appreciate from Fellows their observations on these statistics, and to hear from them their personal experience of this subject.



## THE AFTER-TREATMENT OF DISLOCATIONS OF THE ELBOW, WITH A NOTE ON TREATMENT OF STIFF ELBOWS.

By D. J. GLISSAN,  
*Sydney.*

THE elbow joint bears an unenviable reputation on the score of recalcitrant stiffness after injury and because of the alleged danger of the development of *myositis ossificans traumatica*.

It is the purpose of this short paper to emphasize that the delay in restoration of function following elbow joint injuries is largely dependent on the methods of after-treatment more or less generally used today, and to support this view with the report of my personal experience of a dislocated elbow.

With regard to *myositis ossificans*, I believe that this condition in this country at least is a very rare complication of elbow joint injuries. It is true that the condition is frequently diagnosed on radiographic evidence, but I maintain that in only a small percentage of the cases so reported is the diagnosis correct. Calcification of blood clot about the elbow joint does not constitute the condition of *myositis ossificans*.

When blood and lymph escape from their normal channels as the result of injury or disease, their solid constituents become inert and can be moved from one site to another only by gravity, which may act alone or be assisted by the rolling and squeezing action of the adjacent muscles. Following a dislocation of the elbow there is a copious escape of blood and lymph into the joint and the tissues about it, and when the elbow is placed in the usual position of nearly full flexion, gravity draws them into a perfect cul-de-sac. The effusion cannot escape, for even the rolling action of the adjacent forearm muscles cannot overcome the more powerful and constantly acting force of gravity.

Hence the elbow region becomes surrounded by a stagnant pool of clotting and organizing blood and lymph in that period of three weeks during which we are usually counselled to keep the joint flexed and at rest.

Since dissatisfaction with the usual methods of after-treatment suggested an alternative based on the above reasoning, I welcomed the opportunity provided by a motor accident in which my left elbow was dislocated, to test the efficacy of this alternative. The fact that it was free of the possibility of adverse legal consequences added a little zest to the experiment.



The dislocation occurred in the early morning of December 18, 1931. At the outset pronation and supination and wrist flexion and extension could be carried out freely, but as the escaping blood crept in between the muscles it became more difficult to carry out these movements, and after half an hour it required a considerable effort to do so.

I owe the speedy and efficient handling of the accident and of its painful consequences to Mr. A. P. Gillespie of Goulburn, a Fellow of the College, who kindly gave me a free hand in the after-treatment of my elbow after he had reduced the dislocation. A skiagram taken on the following day showed a small flake of bone torn off the lateral epicondyle, and this region was persistently tender for the following three weeks.

The sling was discarded a few hours after reduction. It gave very little comfort, and I gained the impression that much relief of the pain which persisted after reduction would have been obtained by the use of a firm compression bandage applied to the extended joint. When, a few nights later, I was asked by a colleague to deal with a difficult fracture, I was able to work quite comfortably and without hurt with the help of such a bandage.

The limb was allowed to hang unsupported, and movements of flexion and extension, pronation and supination were practised from the beginning.

From the first day onward the limb was used as far as was possible for ordinary purposes—shaving, bathing, dressing and feeding—and the elbow was expected to play its part. No attempt was made at any time to force it, nor was any movement which caused pain persisted in. The limb was never slung except when sleeping.

At the end of one week the limb was so useful as to render me quite independent of friends or family, and an interrupted fishing trip was resumed. On this date the presence of hard masses of blood clot, immediately beneath the deep fascia, about the extensor origins and between these and the triceps, was noted. The clotted blood and lymph had been worked away from the deep tissues to the surface.

On January 13, that is, the twenty-sixth day after the accident, the fishing party returned and ordinary professional duties were resumed. All movements except the last 20° of extension were freely and painlessly present. Motor car driving was quite comfortably managed, except that a very little discomfort was felt on swinging the wheel hard on the left lock. This was probably related to the avulsion of the small flake of bone already referred to.

By January 31, that is six weeks after the accident, the elbow was functioning fully and painlessly in every respect, and has given complete and satisfactory service ever since.

Extension was the most tardily recovered movement, but it returned unobtrusively without any particular effort being made to secure it.

In this instance the value of careful active physiological use of the limb in restoring early and full function following a dislocation of the elbow was vindicated. Not only did the limb recover its function fully and rapidly, but there was very little interference with the ordinary routine of my life. This interference might have been greater had the right elbow been the affected one, and had I been a manual labourer; but I feel very certain that in any case the period of incapacity would have been greater had I followed the usual method of rest in flexion, followed by the usual so-called passive movements, massage, baking *et cetera*.

My own opportunities for testing this method of treatment on other persons are limited, but in four cases in which I have been able to test it the results were exactly similar to that described in my own case.

In one instance the presence of a hard mass deep in front of the elbow was noted after about fourteen days, and a radiographic report bore the ominous words "probably *myositis ossificans*", but it was obvious that the mass was composed of calcified blood clot rolled into a ball by the action of the neighbouring muscles.

The patient, a young woman, recovered full and painless function in four weeks.

In 1918 I had under my care at one of the military orthopaedic hospitals in Liverpool, England, a sturdy invalid soldier, one of whose disabilities was a stiff elbow. Although the limb looked perfectly normal and radiography disclosed no evidence of any trouble, it was not possible for him or anyone else to move the elbow more than a few degrees on either side of mid-flexion. I noticed that every time I tried to pull it out into extension the flexors of the elbow used to contract to resist me, whilst when I tried to flex it the triceps would come into action, while the patient writhed mutely in discomfort. I could never catch those muscles off their guard, though I spent much time and tried many ways.

It was a vexatious and intriguing joint. The significance of that observation and the method of countering the action of these muscles did not occur to me for some years, although I had noted the same phenomenon subsequently and had pondered over it.

It then occurred to me that either I had tried to do something which was wrong, or that what I tried to do was correct, but that my efforts were misdirected. If the second of these surmises was right, it appeared reasonable to infer that if the wrong method caused the muscles to resist me, then one which would cause them to work with me would be correct.


It was not difficult to find such a method, since it was necessary only to apply the ordinary physiological principles governing muscle action, and to make use of the fact that when one group of muscles contracts voluntarily, the opposing group relaxes and elongates.

A small boy with a post-traumatic stiff elbow presented himself and the theory was put to immediate test. The patient was seated before a shoulder high table, on which the entire upper limb rested comfortably and naturally, the elbow being flexed as far as was possible, and the forearm pronated. A heavy weight, such as a brick, a flat iron, or a smooth mass of lead, was placed on the table, hard against the ulnar border of the forearm, just above the wrist. The patient was then asked to push the weight as far away as possible, moving only his forearm. When he had done this the weight was placed against the radial border of the extended pronated forearm, and he was asked to pull it towards himself as far as he could. It was immediately obvious that now the muscles no longer fought against our efforts, but worked with us, and what was equally as important the patient did the same.

The child no longer thought of his elbow. His whole attention was focused on pushing away and drawing back the weight. He began each movement with a heavy load on the particular muscle group involved. When he came to the resistance offered by his adhesions it was translated to him as merely an extra load, and he put forward greater muscular effort to overcome it. He was interested in his exercise, his parents understood it, and could follow and measure his improve-

ment, and, what is very important, the child was able to carry out his treatment just as adequately at home as at the clinic.

The child recovered his movements rapidly, and since that experiment no other method of dealing with stiff post-traumatic elbows has been used in the treatment of any of my patients. A check made by follow-up of patients makes it quite clear that as compared with cases treated by the ordinary methods of so-called passive movements, massage *et cetera*, the period of disablement when this method is used is less than half.



## LARYNGOCELE IN MAN AND NOTES ON LARYNGEAL SACS IN ANIMALS.<sup>1</sup>

By A. B. KEITH WATKINS,  
*Newcastle, New South Wales.*

EXAMPLES of dilatations and pouches of the respiratory and common alimentary and respiratory passages in animals are extremely common. The cheek pouches in the monkeys and the fish pouch in the pelican are too well known to be dilated upon. A few examples of less well known dilatations are the nasal air sac in the bladder-nosed seal, the sublingual pouches of the great bustard, the huge tracheal sac of the emu, the tracheal dilatation in certain long-necked birds, the dilatation of the lower trachea and main bronchus that forms the organ termed

the syrinx in male members of many birds which quack, and the numerous air sacs which lead off the lungs of birds and which in some cases are continued into the cavities of nearly every bone in the body. The horse also has a great dilatation of the Eustachian tube.

Interesting as these sacs may be, one must pass them by to concentrate on laryngeal air sacs, hoping to derive information of assistance in the elucidation of problems connected with laryngocele in man.

### LARYNGEAL POUCHES IN ANIMALS.

Air sacs from the larynx in animals are of several types. Their study is complicated by the fact that their development is not only affected by age, sex *et cetera*, but is not constant even in specimens from animals of similar sex and age; also frequently development on the two sides varies.

Strangely these sacs, especially those developing from the saccus of



FIGURE 1. Left lateral view of the larynx of a chimpanzee, showing the persistence of the infantile type of laryngeal sac, which arises from the ventricular saccus. (Specimen 1173C, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)

<sup>1</sup> Read at the annual meeting of the Royal Australasian College of Surgeons, Melbourne, on March 5, 1935.

the ventricle of Morgagni, are most developed in animals nearly highest in the animal scale, namely, certain anthropoid apes, whilst in man, at the top of the scale, such air sacs are normally quite absent.

Laryngeal sacs are found almost exclusively in mammals, but do occur in some frogs and toads and in one fish, the gurnet. These sacs are either lateral or median.



FIGURE II. Anterior view of neck of a young male chimpanzee, showing great development of the left laryngeal sac. It descends in the mid-line of the *manubrium sterni* and then has lateral extensions which pass laterally under the sterno-mastoid muscle and lie on the upper ribs behind the clavicle. (Specimen 1173e, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)

#### *Lateral Sacs.*

Some of the lateral sacs arise from the saccus of the ventricle of Morgagni, and this is the type that resembles laryngocele in man. This occurs only in the Siamong gibbon, chimpanzee, orang-utan and gorilla. The literature on the subject is most difficult to follow, as few appear to have had access to sufficient dissections to speak with authority on the variations of development. In all cases, the sacs attain the greatest development in adult males, though sometimes they are large

on only one side. In some cases the adult female also has a great enlargement of them, whilst in others the infantile form persists (see Figure I). In some specimens the size of these sacs is enormous, reaching the subclavicular or even the axillary spaces (see Figures II and III). According to Keith,<sup>(1)</sup> the sacs of opposite sides may fuse. Deniker<sup>(2)</sup> carried out dissections on the foetal gorilla, but in no case could he find the saccus extending outside the thyreo-glossal membrane. He states that after birth the saccus of the ventricle enlarges, and after

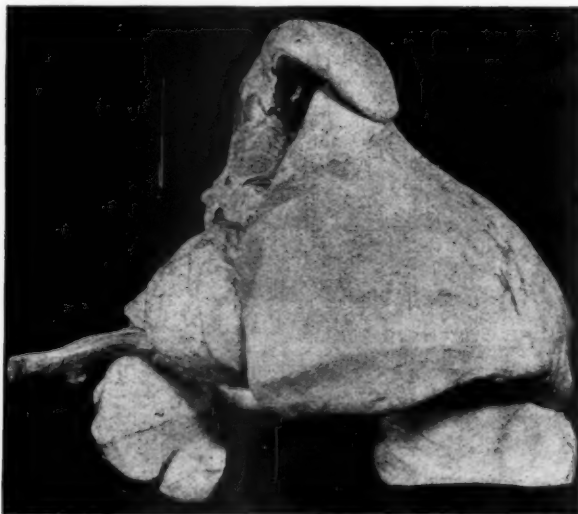


FIGURE III. This photograph illustrates the enormous development of the laryngeal air sacs of a female orang-utan. On the right side the clavicle is surrounded on three aspects by part of one of them. The structure above is the tongue. (Specimen 1173Ba, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)

perforating the thyreo-hyoid membrane the upper portion of the sac develops partly forwards and partly backwards (see Figure IV). Until the sac has reached the size of a pea, bilateral enlargement is usually symmetrical, but after this one side exceeds the other.

In other animals, sacs do not develop from the ventricular saccus, but in many common monkeys they arise from the ventricle itself and have a tendency to extend into and expand the laryngeal cartilages. In these monkeys and the howler monkey it is generally the hyoid which is expanded. In the literature on laryngocele in man many references to the sacs of the howler monkey (see Figure V) have been made, and the statements have been made<sup>(3)</sup> and repeated that the sacs extend into the axilla and that the monkey plays on them like bagpipes. Both

these statements are apparently incorrect. In any case, these sacs are not homologous to the laryngocele of man, for not only are they intra-cartilaginous, but they do not arise from the saccus. In this monkey the two sacs meet and fuse in the body of the hyoid. In some other animals, as the tapir, sea lion and whale, other cartilages than the hyoid are distended by sacs.

#### *Median Sacs.*

Median sacs, unlike the lateral sacs, occur also in other than mammals, but are relatively uncommon.

In the ass (see Figure VI) there is a small median sac opening at the root



FIGURE IV. Left lateral view of a young male gorilla, demonstrating how the laryngeal sac sometimes divides into anterior (*a*) and posterior (*b*) portions after the thyreo-hyoid membrane has been penetrated. (Specimen 1173Baa, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)



FIGURE V. Anterior view of larynx of howler monkey with various windows to show how the air sacs from the ventricular air sacs expand the hyoid bone and fuse with one another in it. (Specimen 1173Ab, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)

of the epiglottis, but there are also lateral sacs opening at the site of the ventricle.

The anubis baboon (see Figure VII) has two air sacs, one much larger than the other, which open by a common passage at the base of the epiglottis.

The tree toad and gurnet have median anterior laryngeal sacs, but one must remember that in the gurnet the larynx is not a respiratory



organ, and, though some varieties of gurnet grunt loudly even under water, we have no certain evidence where the noise is produced.

#### FUNCTION OF LARYNGEAL SACS IN ANIMALS.

We are indebted to Negus<sup>(4)</sup> for the modern view of the subject. Previously it was taken more or less for granted that these sacs were vocal in function. Probably the great development in the noisy howler monkey accounted for this.



FIGURE VI. Posterior view of the larynx of an ass. The black glass rod above the anterior commissure shows the opening of the median sac. The lateral sacs cannot be seen in this view. (Specimen 1170Ak, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)

Against this view, Negus lodged the devastating criticism that they were present in animals who did not use the larynx for making sounds, and that young gorillas without sacs could make as much noise as the adult gorillas with them. Further, these sacs open above the vocal cords, and this limits their powers to that of modifying sounds already produced.

Negus holds, probably correctly, that the function of the majority of these sacs, whether from the larynx or other parts of the respiratory tract, is to enable the animal to hold its breath longer. This is of advantage, not only to aquatic animals, but to those animals who make tremendous exertions with muscles fixed to the chest wall. When great exertions are made in such animals, the muscular mechanism is made more efficient if the chest wall can be fixed, and this is best done by obstructing respiration. When the capacity of the respiratory system is

increased by a large air sac and especially if, as in the great apes, the sac is covered by muscles which squeeze it during exertion, a mixing process is set up which enables the air in the sac to be used for respiratory purposes without relaxation of the fixed chest wall. Further evidence is that these sacs often become inflated when the animal is angry. This possibly is a preparation for exertion, comparable to adrenaline secretion in similar circumstances. Where the sacs are small, Negus holds that they are vestiges of larger sacs which might have been

able to function in this manner in ancestral animals. He admits, however, that the syrinx is a vocal organ, its function being to muffle the quack, producing the low quack of the drake in contrast to the high pitched quack of the duck.

#### LARYNGOCELE IN MAN.

In man, the saccus or appendix which arises near the anterior end of the ventricle of the larynx is well developed in comparison with animals. Its wall contains much lymphoid tissue and mucous glands (St. Clair Thomson<sup>(5)</sup>). Its median surface is covered by a portion of the *aryteno-epiglottideus inferior* muscle, whilst its lateral surface is covered by *thyreo-arytenoideus* and *thyreo-epiglottideus* muscle (Gray<sup>(6)</sup>). Shambaugh<sup>(7)</sup> suggests that it may lubricate the vocal cords, but there are so many other mucous glands present in the larynx that such a function can hardly be necessary. It may be only a remnant of the large extralaryngeal sacs which may have existed in ancestral animals, and which still exist in anthropoid apes. I am not aware that this suggestion has been advanced previously.

Sometimes an air sac termed laryngocele develops from it, but such an event is of the greatest rarity. The condition is not mentioned in St. Clair Thomson's book on diseases of the larynx. A search in 1933 through the catalogues of twenty medical museums in the Library of the Royal College of Surgeons of England failed to discover a single case, though in the Royal College of Surgeons Museum there is a specimen described as a cyst of the larynx which is probably a combined internal and external laryngocele.

In 1910 Hippel<sup>(8)</sup> could find records of only 20 cases, eight of which caused no symptoms and were discovered *post mortem*. In 1921 Iglauer<sup>(9)</sup> accounted for 24 cases, and in 1923 Guerra-Estapé and Suñé-Medan<sup>(10)</sup>

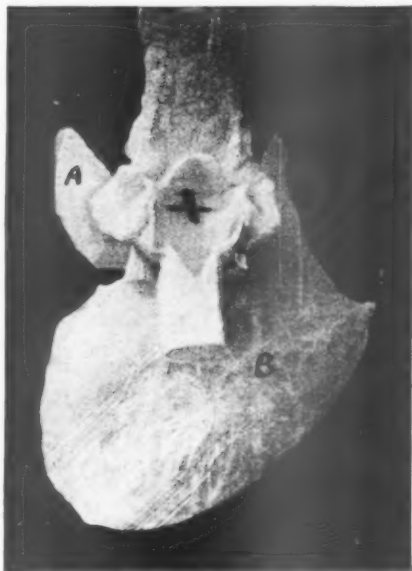


FIGURE VII. Posterior view of larynx of an anubis baboon. The unequally developed air sacs, A and B, open by a common orifice marked with the black glass rod above the anterior commissure. (Specimen 1173Aa, Case 34, Physiological Series, Museum of Royal College of Surgeons of England.)

for 35 cases. Several cases published since have certainly been described more than once, and the total number is still small.

#### *Types of Laryngocele in Man.*

In man, the smaller laryngoceles remain inside the laryngeal skeleton, and are termed internal laryngoceles.

Of those that extend beyond the laryngeal skeleton, two varieties are described. The first—termed superior external laryngocele—becomes superficial through the thyreo-hyoid membrane. The second—termed inferior external laryngocele—is a doubtful entity, but is said to escape from the larynx near the cricoid ring.

Internal and external laryngocele also occur together.

#### *Ætiology of Laryngocele.*

Iglauer<sup>(9)</sup> states laryngoceles may be present at birth, but do not develop until after stress; however, he produces no evidence to support him.

Laryngoceles have been reported in children: Schroder,<sup>(11)</sup> age one year; Guyot,<sup>(12)</sup> age two; Iglauer,<sup>(9)</sup> age three and a half; Revière,<sup>(13)</sup> age four; Avellis,<sup>(14)</sup> age four; Veras,<sup>(15)</sup> age eleven; Guerra-Estapé,<sup>(10)</sup> age six; Garell,<sup>(16)</sup> aged fifteen. They also occur later in life, and Shambaugh<sup>(7)</sup> and Freer<sup>(17)</sup> reported a case commencing at sixty-six years of age. In most cases the onset of the laryngocele has been before the age of thirty. Sex has no influence on the incidence.

Frequently laryngoceles are bilateral, and considerable variation of the two sides occurs.

The production of the sac has been variously ascribed to many factors. The first cases were reported by a French army doctor named Larrey<sup>(18)</sup> in 1829, and his article is worth quoting:

It was in Egypt that we first observed examples of this kind of goitre. It showed itself only in one class of individual, *viz.*, the blind, who are so numerous in that country that religious authorities employ them to chant verses from the Koran from the tops of the minarets every hour of the day and night. These air tumours chiefly develop in those who have "called the hours" for years, and produce pockets under the jaws.

In order to continue the use of their voices, they are obliged to bandage their necks. When the swellings become as large as fists the criers are retired or employed minding the temple pools.

Since returning from Egypt we have found two petty officers afflicted with the same infirmity. Both were old instructors, one a member of the "Ex-garde" and the other of the Royal Guard. One had on both sides of the larynx a tumour the size of an apple, each the same size. These tumours remained, but did not alter the colour of the skin, and they crepitated on pressure. These two cases suffered from aphonia, and could only make themselves heard (in a bass voice) by pressing on the swelling with their hands.

These instructors had been obliged to shout loudly for years. Like the Egyptian cases, they suffered from headache due to pressure on the internal jugular veins.

Since this report, others have ascribed the occurrence of laryngocele to various causes. Hippel<sup>(8)</sup> ascribed it to politizerization; Spicer,<sup>(19)</sup> to

a cold; Noury,<sup>(20)</sup> to a cough; Guerra-Estapé and Suñé-Medan,<sup>(10)</sup> to whooping cough; Garel,<sup>(16)</sup> to one too suddenly raising the head, and another to a polypus in the sinus of Morgagni; Landry,<sup>(21)</sup> to glass blowing; Frank,<sup>(22)</sup> to an acute cry; Gluckberg,<sup>(22)</sup> and Pantaloni,<sup>(22)</sup> to lifting weights; Harold,<sup>(22)</sup> to blowing a clarionette; Gongenheim,<sup>(22)</sup> to blowing a hautbois; and Pantaloni,<sup>(22)</sup> to blowing a trumpet. Without giving details, Guerra-Estapé and Suñé-Medan<sup>(10)</sup> state other causes have been vomiting and bearing down in labour, trauma, syphilis and tuberculosis.

It will be seen that forced expiration is definitely a factor in the development of laryngocele.



FIGURE VIII. Diagram of internal laryngocele on quiet respiration and after forced expiration. (Cliché Labarraque, *Annales des Maladies de l'Oreille, du Larynx*, Volume xliv, Number 4, April, 1925, page 408.)

#### Symptoms.

*Internal Laryngocele.*—In internal laryngocele the air sac fills intermittently, generally during forced expiration, producing a swelling of the false vocal cord, extending sometimes to the ary-epiglottidean fold or even the base of the tongue (Freer<sup>(17)</sup>).

In the majority of cases collapse of the sac takes place as soon as quiet respiration occurs. Sometimes the swelling persists for a variable time, causing various degrees of dysphagia, sometimes ending fatally.

Various degrees of dysphonia may be present when the sac is collapsed, and this is greatly increased when the sac fills.

The appearance on forced phonation is usually that of a tense rounded tumour above one vocal cord (see Figures VIII and IX). On quiet respiration the size of the tumour decreases and may become convoluted, when it can be seen that the tumour has its origin between the edge of the ventricular band and the ary-epiglottidean fold, and is situated near the anterior part of the larynx. In larger cases, the

ary-epiglottidean fold or even the base of the tongue may become distended by the swelling.

*Superior External Laryngocele.*—When unaccompanied by internal laryngocele, the only symptom of superior external laryngocele is a painless cystic swelling of the neck which appears on forced expiration and which subsides at once on resumption of quiet breathing. In some cases the cyst remains partly or fully inflated until it is emptied by external pressure, when a gurgle can be heard with or without a stethoscope. Such artificial collapse of the cyst often produces an attack of coughing, especially if infection is present. In some cases these cysts have remained filled when the subject is in the erect posture, but have emptied when he lies down (Veras<sup>(15)</sup>).

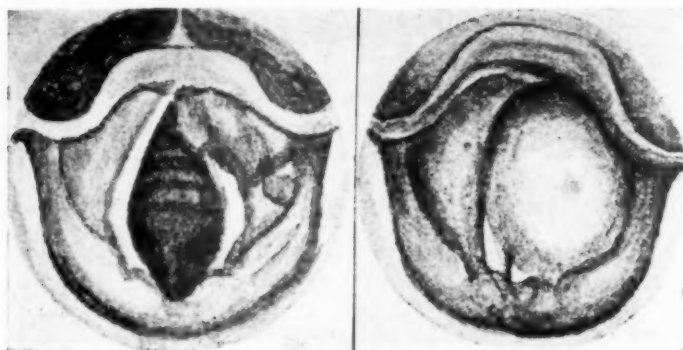


FIGURE IX. Diagram of internal laryngocele on quiet respiration and on saying "Ah". (From article by F. Spicer, *Proceedings of the Royal Society of Medicine*, Volume xiv, 1920-1921, Section of Laryngology, page 17.)

In bilateral cases, on rotating the neck, it may be found that forced expiration results in inflation of the sac on the side to which the head is rotated only (Guerra-Estapé and Suñé-Medan<sup>(10)</sup>). This is due to compression of the sac of the opposite side by the sterno-mastoid muscle.

Diagnosis has been verified by puncture of the sac and the escape of air.

When small, these cysts commence in the thyreo-hyoid space, but as they enlarge they extend downwards. After the cyst has once appeared it often increases in size, rapidly at first, for a few months.

Their size varies, having been reported as small as hazel nuts and also large enough to reach the clavicles. Shambaugh<sup>(23)</sup> mentions pain as being usually the first symptom, but other observers do not refer to this, and even stress the painlessness of the developed condition.

The appearance of the larynx is variable. In many cases it is normal. Laryngitis is frequently observed. Distortion of the ventricular band also occurs. In the majority of reports reference to the appear-

ance of the larynx is omitted. When this is included there is frequently an internal laryngocele present also.

X ray examination has demonstrated deflection of the trachea to the opposite side, and should demonstrate the air sac, but in this connexion it must be remembered that the *fossa pyriformis* becomes quite a large space during forced expiration.

As Larrey<sup>(18)</sup> pointed out, the size of the sac may cause headache from venous obstruction, though he appears to be alone in making this observation.

Serious symptoms from this form of laryngocele do not occur until infection supervenes. This complication has not been often noted, but in the history of cases pneumonia and chronic bronchitis are commoner than one would expect if infection is as rare as the few reported cases would suggest. In some cases, large quantities of pus are expectorated, when the discharge is increased by pressure on the neck. Such a complication naturally greatly increases the difficulties and risks of radical treatment.

*Inferior External Laryngocele.*—Inferior external laryngocele is referred to in the literature on the subject, but such mention is chiefly in the French journals.

There seems no evidence that any such cases have been verified by dissection or operation. Presumption that a laryngocele is of this variety has been made on insufficient evidence. As an example, Veras<sup>(15)</sup> described a male patient with a bilateral swelling of the neck. The interior of the larynx appeared normal, though the voice was "veiled".

He described this case as one of the inferior external type because the main swelling was below the *pomum Adami* and because pressure on both sides of the neck was required to empty the sac completely. Such reasons fail to carry conviction, and for the present one does not accept the occurrence of this type proven.

#### Morbid Anatomy.

Considering the size of the literature on the subject, it is surprising that more information is not available on the detailed anatomy of these



FIGURE X. Diagram of a dissection of a bilateral superior external laryngocele discovered accidentally after death in a male glass-blower. (Cliché Landry, *Annales des Maladies de l'Oreille, du Larynx, du Nez et du Pharynx*, Volume xlv, Number 4, April, 1925, page 402.)

cysts. Few details of the anatomy are available, and only one museum specimen that might be a laryngocele has been found.

Landry<sup>(21)</sup> describes a double superior external laryngocele discovered in the dissecting room in a glass blower. The patient, a male, age fifty-six, had died of pneumonia. "He had never had laryngeal trouble, but could blow up a lump on both sides of his neck to the size of a large orange."

The anatomical description is scanty, except for the statement that there were two large pouches corrugated longitudinally and communicating with the appendices of the ventricles, and that they were situated (as one would have expected) under the sterno-hyoid and thyreo-hyoid muscles. Fortunately, a drawing of this dissection exists (see Figure X).



FIGURE XI. A probable example of combined internal and superior external laryngocele in man. The larynx has been laid open posteriorly. [Specimen 5704-1 (O.C. 3502A), Lower Gallery, Room 1, Royal College of Surgeons of England.]

The possible specimen of a combined internal and external laryngocele is in the Royal College of Surgeons of England [15704-1 (O.C. 3502A)], and is described as a cyst of the larynx (see Figure XI). The description states:

Projecting into the larynx close above the right ventricular band is a spherical cyst about the size of a small cherry which is prolonged by a constricted process through the thyreo-hyoid membrane, beyond which a larger cyst lies in front of the right cornu of the hyoid bone and thyreo-hyoid membrane. There is a communication between the ventricular cyst and the external cyst, which probably arose from the former by a protrusion through the thyreo-hyoid membrane at the

site of a natural nerve or vascular perforation. The right upper cornu of the thyreoid cartilage is absent, being presented by a narrow fibrous cord. The cyst was furnished internally with an epithelial lining.

The specimen was from a female, aged fifty, who had been hoarse for three years, with stridor for a few weeks. Puncture of the internal cyst gave temporary relief. At a subsequent attempt, death occurred under the anæsthetic.

Lemaitre and Halphen<sup>(24)</sup> recorded histological findings on a piece of laryngocele submitted for examination. The report ran:

The pouch was lined with mucosa clearly lined with columnar epithelium. Considerable lymphoid hyperplasia and infiltration. One slide shows a lymphoid



mass, the significance of which appears important. These lymphoid masses in a number of preparations make one think of a laryngeal tonsil of the ventricle.

This examination shows that the cyst wall in this case was similar to the saccus of the ventricle of Morgagni.

#### *Treatment.*

The majority of external laryngoceles have received no treatment. In others, a bandage only has been used to control the swelling or to make speech possible.

Ingals<sup>(25)</sup> treated a combined internal and external laryngocele by injecting into it equal parts of a 95% solution of carbolic acid and glycerine. This produced a temporary cure, but the internal portion recurred. Most would, however, consider the injection of such a solution into a cyst communicating with the respiratory passages to be reprehensible.

The case referred to as having been caused by a polypus was cured by removal of the polypus.

Removal of the sac by external operation has been carried out successfully, but recurrence is not unknown. When infection has occurred, the procedure is more difficult and dangerous.

As the most important reason for operation is the prevention of the occurrence of infection in the sac, this should be undertaken early. Probably the operation would be easier if a dye such as methylene blue were injected into the sac and if its inspiration were prevented by intratracheally induced anaesthesia.

Treatment of internal laryngocele is more urgent owing to the danger of dyspnoea. Acute dyspnoea has been treated by puncture of the cyst via the mouth, and cure has been temporarily effected by slitting the median wall of the cyst by the same route. The radical operation consists of approaching the submucous area in which the cyst lies and stripping out the cyst. This area has been reached by a median laryngofissure type of operation, the mucosa of the larynx not being opened; but Lewis<sup>(26)</sup> and Freer<sup>(17)</sup> suggest a more direct approach by dividing the thyroid cartilage vertically away from the mid-line. More care is necessary by this route in dividing the cartilage, for if this were done too deeply the vocal cord would be injured.

#### *Discussion on the Production of Laryngocele.*

There is definite evidence that chronic straining favours the development of laryngocele. On the other hand, laryngocele develops relatively commonly in young children who have not been subjected to strains such as occur in an occupation like glass blowing. Also, the resemblance between superior external laryngocele and the laryngeal sacs of anthropoid apes is so great that one cannot but believe that there is a connexion between the two. In these cases, one is driven to the conclusion that the tendency, inherited from anthropoid-like forbears, to

develop these sacs can be so great that they can form without much or any assistance from especially high intralaryngeal pressure.

The difficulty to assess the factors in development is much greater when a laryngocele occurs in a person subjected to chronic respiratory strain.

Strain is such an undoubted factor in the history of many cases that its influence cannot be doubted. The point for discussion is whether the strain acts: (i) by bursting through the laryngeal skeleton as a direct inguinal hernia escapes through the abdominal wall, (ii) by distending a sac already present as strain forces gut into a patent *processus vaginalis* in oblique inguinal hernia, or (iii) by increasing the tendency to develop an ancestral organ.

A dissection of a human larynx shows that the apex of the saccus of the larynx can extend to within a millimetre or so of the thyreo-hyoid membrane, the two being separated only by a loose tissue. Also the thyreo-hyoid membrane between the median and lateral thyreo-hyoid ligaments is much more delicate than most imagine. It is therefore quite conceivable that strain could produce a hernia through a natural opening in it without an inherited disposition.

The tendency to develop these sacs even in anthropoid apes is not present until after birth. In fact, Deniker<sup>(2)</sup> states that in the gorilla and chimpanzee the sacs may not begin to develop until the time of the first dentition. It is therefore not difficult to believe that when such a bygone tendency recurs in human beings, there might be some variation such as a tendency to develop it later in life than was the ancestral rule.

If a small sac protruded just through the thyreo-hyoid membrane of an adolescent, it is quite likely that it might never be noticed until he went to work and engaged in a straining occupation. When this was commenced, the sac would be expected to distend rapidly.

It is therefore possible that strain can have all the three effects suggested for discussion in different individuals.

In connexion with the type of strain which would tend to develop a laryngocele, one might point out that phonation causing expiratory obstruction at the site of true vocal cords is insufficient, as this is below the ventricle. In order for this to be a factor, phonation of a violent character causing approximation of the false vocal cords also is necessary. Any obstruction between this site and the lips would increase intraventricular pressure.

#### *Differential Diagnosis.*

1. *Pneumatocoele of Wharton's Duct.*—Pneumatocoele of Wharton's duct is another of the rather interesting trade diseases of glass blowers. One would expect to find this swelling higher in the neck, and probably it would bulge into the intraoral sublingual region when the mouth was opened. If there were any doubt, the cyst could be emptied by

pressure whilst saliva or water in the mouth covered the papillæ of Wharton's duct, when air would be seen to bubble out, or lipiodol injection and X rays could be used.

2. *Hernia of the Lung*.—In regard to hernia of the lung, differential diagnosis is necessary only when the hernia enters the neck. These herniæ are almost always traumatic, and the scar must be searched for, not only at the root of the neck, but also in the subclavicular region, for there have been cases in which lung has escaped through



FIGURE XII. The patient A.T.W. on quiet and forced respiration. He presented cervical and laryngeal symptoms of laryngocele caused by a plunging intrathoracic goitre.

the scar of a wound below the clavicle and has passed up behind the clavicle to appear in the neck. If any difficulty in diagnosis is experienced, an artificial pneumothorax and X ray examination might dispel it.

3. *Prolapse of the Sinus of Morgagni*.—There is a possibility of confusing prolapse of the sinus of Morgagni only with the internal variety of laryngocele. In both the intralaryngeal swellings are intermittent. In the case of prolapse, however, the swelling is situated at a lower level than internal laryngocele, and the upper edge of the swelling can be seen to come directly from the lower border of the false vocal cord. In many cases, also under local anaesthesia, the prolapsed mucosa can be replaced by a probe.

4. *Intrathoracic Tumour.*—Some tumours of the superior mediastinum, especially intrathoracic goitres, have the power, during forced expiration, of ascending into the neck to a considerable degree. When first seen these tumours may have already become so large that it is difficult to tell whether the swelling has been pushed from below upwards on expiration, or whether it is a sac which might have become distended *in situ*. Added to this, pressure distortion on the larynx can produce a laryngeal picture compatible with laryngocele. The following case illustrates these facts.

A.T.W., a male, aged twenty-seven years (see Figures XII and XIII), an electrical instrument maker, who had never blown wind instruments, when applying for treatment for acute tonsillitis, complained that since the age of five he had

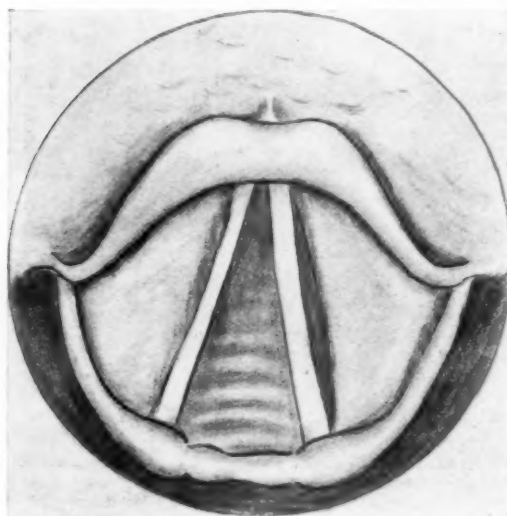


FIGURE XIII. The laryngeal appearance of A.T.W., who also presented cervical signs compatible with a laryngocele, due only to a plunging intrathoracic goitre.

been able on forced expiration to make a swelling appear on the left side of the neck, extending from the level of the thyrohyoid region to the clavicle. There was no dyspnoea. He had not noticed any dysphonia, but his voice had an unusual quality difficult to describe. On cessation of expiration the swelling disappeared suddenly. It was too soft to be moved by digital manipulation. On examination, he had an acute tonsillitis, and there was an abnormal laryngeal appearance, the left vocal cord being about one and a half times the width of the right, and there was a funnel-shaped depression between the left true and false cords. There were no signs of hyperthyroidism.

In 1929 the patient was shown at an otorhino-laryngological clinical meeting in Sydney, and the condition was

accepted as a probable case of laryngocele. The same year an X ray examination failed to reveal an intrathoracic lesion.

The patient returned in 1933, knowing that his condition was regarded as interesting. Another X ray examination showed that the trachea in the upper part of the thorax was displaced five centimetres (two inches) to the right of the mid-line, whilst there was a large rounded swelling in the left side of the superior mediastinum extending into the neck. On expiration, the major portion of the swelling was extruded into the neck. The laryngeal condition was unchanged.

A diagnosis of intratracheal goitre of the plunging variety associated with pressure distortion of the larynx was definitely made. The nature of the distortion was that the lower portion of the ala of the left thyroid cartilage

was pushed towards the mid-line. This allowed one to look into the ventricle, and exposed more of the width of the vocal cord.

Although no dyspnoea or hyperthyroidism was present, operation was advised, the displaced trachea suggesting that dyspnoea might develop later, when interference would be urgent and more dangerous.

On October 26, 1934, Dr. Gardiner operated through a low collar incision and removed a cyst of the left lobe of the thyroid gland. It extended from the left upper border of the thyroid cartilage to the level of the aortic arch. As it descended, it displaced the trachea forwards to the right and the oesophagus backwards and to the right, a portion of the cyst passing between these structures.

The patient made an uninterrupted recovery.

#### ACKNOWLEDGEMENTS.

In conclusion, I wish to tender grateful thanks to the Royal College of Surgeons of England for the provision of facilities for photographing most of the specimens which illustrate this paper, and for permission to publish them, and also to the Royal Society of Medicine and the publishers of *Annales des Maladies de l'Oreille, du Larynx, du Nez et du Pharynx* for permission to reproduce illustrations.

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## Surgical Technique.

### AN IMPROVED TECHNIQUE FOR ENCEPHALOGRAPHY.

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and the Department of Surgery, University of Sydney.]

THE diagnostic procedure of encephalography has already been fully discussed in its special reference to traumatic focal lesions of the brain (in THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY, July, 1932, by Money and Susman); and it is not proposed now to reconsider its many aspects in detail. Suffice it to say that, in our experience, which now amounts to over fifty cases, the statements made in the previous article concerning the value of encephalography, its indications, contraindications and the need for adherence to a rigid routine, still hold good. No fatalities have occurred in this series, the majority of which have been carried out on patients suffering from post-traumatic sequelæ. Several of the patients suffering from the symptoms of "traumatic neurasthenia" and epileptiform fits, following a minor head injury with no demonstrable focal lesion, have secured permanent relief or definite alleviation of their condition after the procedure, thus demonstrating its therapeutic as well as its diagnostic value.

#### Disadvantages of Original Methods.

As further experience was gained in carrying out encephalography, the following disadvantages were soon apparent:

1. The method was slow and time-consuming; each performance took about one hour and was trying to the nerves of both patient and operator alike.
2. Raising the patient from the lateral horizontal position on the table to the vertical with legs hanging over the edge of the table was a difficult procedure and liable to dislodge the needles from the lumbar canal. Supporting the patient in this posture required the services of a nurse or extra assistant.
3. The process of allowing the cerebro-spinal fluid to run off freely until the pressure reading was 8 or 10 millimetres of mercury, and then injecting air from a 10 or 20 cubic centimetre syringe, produced a sudden severe headache, nervous shock, and occasionally sweating and collapse, however slowly and carefully it was done. Each additional syringeful of air increased these symptoms.
4. In the absence of a fixed support for the head it was difficult to maintain the correct posture.
5. Lifting the patient down from the table to the stool was a clumsy undertaking. It was also very awkward to maintain the erect posture on a stool during the taking of the pictures, and to change the patient from one posture to another with ease and rapidity.

#### Alterations in Procedure.

The radiological technique has not been altered in any way. Occasionally additional exposures have been made with the head fully extended or fully flexed in the lateral positions, to demonstrate especially the anterior or posterior horns and the third ventricle, but these variations will not be further discussed here.



The apparatus used has been the "Keleket" angulating counterbalanced headstand, with vertical Potter-Bucky diaphragm, belonging to the Surgical Professorial Unit at the Royal Prince Alfred Hospital. Excellent filling of the ventricles, arachnoidal cisternæ and cortical pathways was obtained after injection of the air by a syringe. It was not to improve these results that alterations have been made, but to make the performance more comfortable for both patient and operator. No claims of originality are made for the improvements in technique to be described, either for the chair or the "continuous flow" apparatus, except as far as their use in this country is concerned.

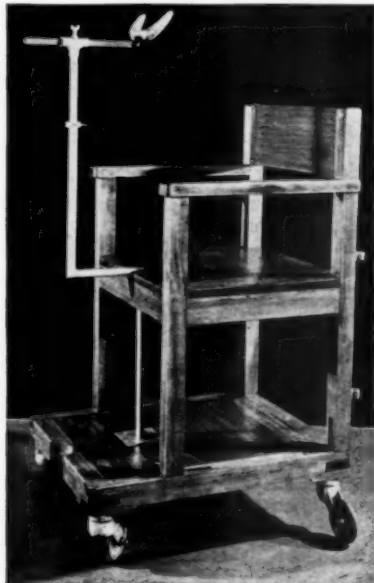


FIGURE I. Encephalography chair and head support, back-rest in position.

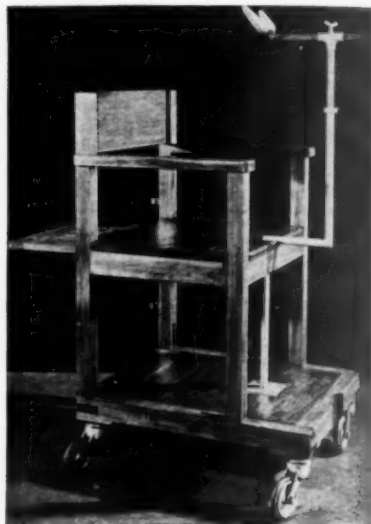


FIGURE II. Encephalography chair with manometer platform pulled out.

#### The Construction of an Encephalography Chair.

During a visit made to Professor Frazier's clinic at Philadelphia in 1928, an encephalography chair was demonstrated by Gardiner and Wagoner, and, on a rough sketch made of this at the time, the one now in use was modelled. Its design can be readily appreciated from Figure I. Its chief features are: (i) stability, (ii) easy mobility in all directions within its own wheel base, (iii) portability over distances, (iv) adjustable platform for manometer (see Figure II), (v) removable supports for patient's head and back (Figure III), (vi) fixed supports for forearms and feet.

It was found that there was seldom any need to take a reading of the cerebro-spinal fluid pressure with the patient lying down at the commencement of the procedure, because this had usually been done previously in the wards at lumbar puncture to obtain fluid for the Wassermann test *et cetera*. Consequently, the patient is at once made to sit upright comfortably supported in the chair; and needles are inserted into the lumbar canal through the third and fourth spaces, with the back of the chair removed. This avoids much unnecessary

movement and difficulties in supporting the head. The platform is pulled out and a manometric reading made from one of these needles with a mercury manometer (see Figure IV). If the pressure is within the limits of safety, the test is proceeded with. Up to the present time, the inability to adjust the size of the chair to suit patients of different heights has not been a disadvantage. The head-rest is readily adjustable; it can be lowered when it is desired to "gyrate" the patient's head, and removed altogether whilst the pictures are being taken, before which time the platform is pushed in and the back-rest is reinserted.



FIGURE III. Patient in position in chair.



FIGURE IV. The back-rest removed, two lumbar puncture needles inserted, and a manometric reading being made.

#### The "Continuous Flow" Apparatus and Method.

Whilst pondering on a method of overcoming the disadvantages mentioned above of the syringe method of injecting the air, I received a letter from McKenzie, of Toronto, in which he wrote:

There is a technique which I believe you would like better than the syringe method. Someone in the States developed it years ago, and I first saw it at Bailey's clinic in Chicago; I don't believe it has ever been reported. I have made a sketch which illustrates the principle of the apparatus, and you can easily make one for yourself. With this technique there is not nearly so much shock or headache during the procedure.

Some time after the receipt of this letter a reference to this method was found in Bailey's book, "Intracranial Tumours", at pages 422 and 423, where it is called the method of Bleckwenn.

In accordance with McKenzie's sketch, an old glass burette was obtained, graduated to hold 100 cubic centimetres, with an unmarked "dead space" of about 15 to 20 cubic centimetres at the lower end and a larger "bulb" of about 50 cubic centimetres at the upper end. The top and bottom were drawn out so as to fit inside two pieces of fine rubber tubing, which could be connected



FIGURE V. The needles connected to the burette with fine rubber tubing. Cerebro-spinal fluid flowing out of the lower needle is seen rising up the burette and displacing the air into the spinal theca through the upper needle.

readily with "Record" fittings to the lumbar puncture needles (see Figure V). Two metal clips were fastened on to the upright of the chair to hold the burette. As soon as the manometer is disconnected, the longer piece of tubing from the lower needle is connected to the bottom of the burette and the fluid is allowed to flow. When the fluid has reached the zero mark in the burette (that is when about 20 cubic centimetres of fluid have escaped), and not before, the shorter piece of tubing from the upper end is attached with an accurate airtight fit to the upper needle. This insures that more fluid is removed than air injected. Then, as the fluid continues to rise in the burette, an equal volume of air is forced out through the upper needle into the spinal theca. The whole system is a closed one and the flow of both cerebro-spinal fluid and air is continuous. In practice, two lumbar puncture needles of the same bore have worked satisfactorily. If the burette has been carefully washed out with spirits and dried, the contained air is sterile for all practical purposes. The fluid may be allowed to run until it stops, usually after about 150 cubic centimetres have been removed, and the cranial cavity has been "dried out" completely. A manometric reading is then taken and will register nearly zero. This method is of advantage in milder cases of suspected arachnoidal adhesions, when a therapeutic effect is desired. Usually, however, when a diagnostic effect only is desired, it is sufficient to remove about 120 cubic centimetres of fluid and to inject about 100 cubic centimetres of air. A final manometric reading is made, which should not exceed 10 millimetres of mercury. Very satisfactory pictures have been obtained by this procedure in both methods. On account of the gradual and continuous replacement of the cerebro-spinal fluid by the air, there is no rapid change in intracranial pressure, and the patient is able to adjust himself to the altering conditions. Headache, shock and general malaise have been greatly reduced in severity. The whole test can be performed in about twenty minutes, if the fluid flows well. Another advantage of the method is that the head can be "gyrated" and rotated, actually whilst the air is entering the cranium, and a more even distribution can thus be obtained.

The chief disadvantage occurs in cases with well formed adhesions, when the cerebro-spinal fluid may be loculated in areas of the spinal theca or in the arachnoidal cisternæ; then the fluid stops running after about forty to fifty

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cubic centimetres or less have run out. In these cases it is better to disconnect the burette altogether and to finish the investigation by the syringe method. The air may be injected from the syringe with sufficient force to break down these adhesions and thus reestablish the flow of cerebro-spinal fluid.

The other disadvantages may be that continuous manometric pressure readings cannot be taken, as in the old method; but these are hardly necessary, when it is only gravity which makes the fluid flow and the air enter. No positive pressure at all is exerted.

As soon as sufficient air has been allowed to enter and has been well distributed inside the skull, the tubes are disconnected, the burette is removed, and the lumbar puncture needles are withdrawn. The platform is pushed in, the back-rest is reinserted and the head support is removed. The chair is wheeled over to a position in front of the upright Potter-Bucky diaphragm of the X ray machine, and the four routine exposures are made. The rest of the procedure is the same as previously described.

## A NEW OPERATION FOR THE FIXATION OF THE SACRO-ILIAC JOINT.

By N. D. ROYLE,

Honorary Orthopaedic Surgeon, Lewisham Hospital, Sydney.

FIXATION of the sacro-iliac joint is rarely called for. It is only when the arthritis, which is the commonest cause of sacro-iliac disability, resists my usual method of treatment, namely, a rubber belt, a spiral spring bed and a pathogen selective culture vaccine, that the fixation should be effected.

Out of ninety-four instances of this disease the patient's sacro-iliac joint has been fixed in one, a female patient, for excruciating pain which confined her to bed. Even rest in bed failed to relieve the pain, and sedatives were of little avail. The pain was so constant and the joint so tender that newgrowth was suspected. The tenderness in the sciatic nerve was so great that the patient could not put her heel to the ground.

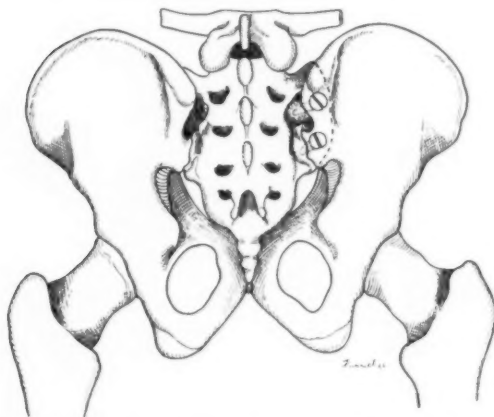


Figure showing position of screws in the sacro-iliac joint.

### Operation.

The following operation was performed. An incision was made over the left sacro-iliac joint down to the *gluteus maximus* muscle and exposing the crest of the ilium 3.75 centimetres (one and a half inches) above the posterior superior spine, the spine itself and the posterior inferior spine of the ilium. A sharp pointed dissector was then passed through the sacro-spinalis muscle until the sacro-iliac ligament at the medial side of the joint on the gluteal surface was reached. This was measured so that the position of the joint on the gluteal surface was approximately known. After the fibres of the *gluteus maximus* had been split, a 7.5 millimetre (five-sixteenths of an inch) drill was then used to drill the sacro-iliac joint from the posterior aspect. It was easy to tell when the bone had been drilled because of the lessened resistance. With a dissector the anterior ligaments of the sacro-iliac joint were felt and the depth of the hole was measured. A three-eighths of an inch tap was then used and a thread was cut in the drill hole. A 4.5 millimetre beef bone screw was cut to the required length. My screws were about 5.0 centimetres (two inches) long and one had to be cut to about 3.75 centimetres (one and a half inches). The screw was then screwed home. Using a similar technique, I placed a screw in the joint in the region of the posterior inferior iliac spine. The wound was closed without drainage.

The relief of pain was immediate. The patient was walking in fourteen days, and has continued without pain in that joint or in the sciatic nerve now for a period of over two years and a half.

## Case Reports.

### DIAPHRAGMATIC HERNIA IN CHILDREN.<sup>1</sup>

By H. DOUGLAS STEPHENS,  
Melbourne.

In presenting this report of six cases of diaphragmatic hernia I wish to express the opinion that the condition is not very rare; that it is difficult to be sure of a diagnosis from clinical signs alone without the aid of radiography; and that surgery offers a prospect of cure in suitable cases.

In respect to the frequency of this condition Dickson, in *The Canadian Medical Association Journal* of July, 1933, points out that prior to 1908 only ten cases were recognized before autopsy.

Since 1908, coincident with the application of radiology to the investigation of the gastro-intestinal tract, all varieties of diaphragmatic hernia have been shown to be of comparatively frequent occurrence rather than rare autopsy findings. Hedblom in 1931 actually collected reports of one thousand and three cases from 1900 and emphasized the failure to arrive at even a reasonable number of correct diagnoses without most careful X ray assistance.

Harrington, of the Mayo Clinic, in *The Journal of the American Medical Association*, September 23, 1933, said that approximately five times as many cases were recognized in the last eight years as in the previous twenty-four years, and that he believed the condition to be even more frequent than the present views indicated. Of his series of two hundred and six cases, one hundred and sixty-eight were herniæ through the *hiatus œsophagi*, and most of these he considered to be of congenital origin. They are notoriously difficult to diagnose in infancy and childhood, only appearing to cause symptoms in later life.

At the seventh annual meeting of the Royal Australasian College of Surgeons in Adelaide in February, 1934, I described four cases of diaphragmatic hernia, in which most of the left hemithorax was occupied by abdominal viscera. I also submitted two other cases, one under the care of a colleague, illustrating a large hernia through the *hiatus œsophagi* and the other a typical example of the variety known as thoracic stomach, with a congenitally short œsophagus.

Prior to this annual meeting I had not seen a case of hernia through the foramen of Morgagni, but at that meeting Dr. Ian Hamilton showed a *post mortem* specimen of this very rare condition.

Of the first four patients three were operated upon by me and the hernia in these three cases was entirely devoid of any sac; and I have no doubt that the fourth was exactly similar, although I had no opportunity of verifying this. In none of these cases was there any evidence which might suggest forcible compression of the abdomen at birth as the cause of the herniation through the diaphragm. In all three cases in which operation was performed hernia had occurred through the left leaflet of the diaphragm laterally and postero-laterally, in the region of that questionable area known as the pleuro-peritoneal foramen (of Bochdalek).

<sup>1</sup> Read at a meeting of the Royal Australasian College of Surgeons, Adelaide, March, 1934.

Those, however, which occur at the œsophageal hiatus almost invariably possess a sac, as is well seen in Mr. Osborn's case included in this series.

A detailed report of these six cases, including their radiographic appearances, is here presented.

#### Case I.

Shirley S., female, was seen on April 29, 1927; she was aged five weeks. She was a second baby, born at full time, and although an anæsthetic was given at the confinement, it is doubtful whether instruments were used. She was



FIGURE I. Radiograph, Case I, before operation.

breast fed and sucked strongly. The first baby had died of summer diarrhœa, aged one year. The mother stated that when ten days old the baby took a "turn" in the night, in which she became purple and vomited a good deal. A week later she had another vomiting turn, with green vomit, frequent green motions, and she passed very little urine for some time. From the first "turn" at ten days she had always seemed to have some difficulty with breathing, and this became worse. At first the turns were once or twice in the twenty-four hours, but these became much more frequent and were generally accompanied by cyanosis. They came on at any time, irrespective of food, generally beginning with a grunt. She then gasped for breath, and on rare occasions brought up slime with a little milk. and seemed easier after a "turn". Her weight remained stationary. On examination the breathing was almost entirely costal in type, her temperature  $37.1^{\circ}$  C. ( $98.8^{\circ}$  F.), her pulse 128 and her respiration 44. There was marked diminution of breath sounds on the left side of the chest, with occasional resonant rattles, but no borborygmi were noticed until I had examined her on several occasions. The percussion note was dull, and for that reason the local doctor had inserted an exploring needle without any result. The heart sounds were clear and much better heard to the right of the sternum than to the left, and the cardiac dulness was elicited as far as the nipple line to the right. Her respirations were always between 40 and 50, and on occasions when examined were 68. She seemed easier when lying on her face, a fact corroborated by her mother. The upper part of the sternum appeared to be slightly projected forward. The abdomen was somewhat shrunken, the liver being situated in its normal position and about 2.5 centimetres (one inch) below the costal margin. There

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was a lump palpable in the left hypochondrium which suggested a spleen, but which was indefinite enough to have been a kidney. The urine was clear and acid and contained no albumin or sugar. I regarded the condition as a left-sided diaphragmatic hernia of large size and referred her to the radiologist. X ray examination confirmed the diagnosis (Figure I). It showed large and small intestines in the chest as high as the second costal cartilage, but the stomach remained in the abdomen.

The baby was referred to the Children's Hospital for operation. During the first two days in hospital she had several cyanotic attacks, which were brought on generally after the baby commenced to feed. Further investigations by the honorary radiologist (Dr. Hewlett) showed barium in the left chest twenty-four hours after a meal.

On May 16, 1927, under intratracheal ether anaesthesia, I cut down on to the eighth left rib. Between 10.0 and 12.5 centimetres (four and five inches) of the rib were removed subperiosteally and the pleura was exposed. On incision of the pleura, coils of bowel immediately presented, no sac being present. The major portion of the small bowel was in the chest, also several inches of large bowel, including the caecum and appendix.

On examination an opening about 3.75 centimetres (one and a half inches) in diameter was found in the left diaphragm a little posterior to its most convex portion. The diaphragm itself appeared to be very thin and the muscular fibres poorly developed. The left lung was collapsed in the upper posterior part of the thorax. With considerable difficulty the bowel was pushed back into the abdominal cavity. The edges of the diaphragmatic opening were then seized with catch forceps and the hiatus was closed with chromicized catgut sutures. The left lung expanded fully towards the end of the operation. This was due to the efforts of Dr. David Brown, the anaesthetist, who skilfully increased the intrapulmonary pressure. The chest wall was then closed. The baby was extremely shocked after the operation, but its condition slowly improved after it was put into a hot air bed and was given saline solution, glucose and brandy by the rectum.

From then on the baby's condition slowly but steadily improved and, apart from a post-operative rise of temperature, due probably to a little fluid in the pleural cavity, nothing further happened and the child gained weight steadily. Two months later she was given another barium meal and a radiological examination was made. The following is Dr. Hewlett's report on the plates:

"No abnormal shadow above the left diaphragm. Heart in normal position.

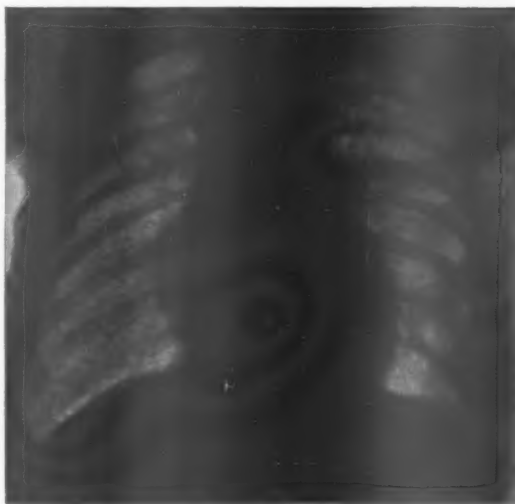


FIGURE II. Radiograph, Case I, two months after operation.

Appendix appears to be rising up from the caecal apex in the right iliac fossa" (see Figure II).

In view of the fact that the appendix in this case was almost under the left clavicle at the time of operation, I concluded that the infant must have some congenital anomaly of the mesentery, and ventured the opinion that volvulus with obstruction was a possibility later.



FIGURE III. Radiograph, Case II, before operation.

punctured with a needle. I could not proceed further with the operation as the baby's condition became desperate. It was returned to bed, where it died shortly afterwards.

From the *post mortem* findings it was obvious that the original hiatus had yielded slightly, and that some herniation had occurred, but the cause of death was obstruction of viscera caused by another herniation situated more posteriorly and extending up well towards the upper part of the thorax behind the heart. This was probably due to increased intraabdominal pressure subsequent to the first operation acting upon a congenital want of development of the diaphragm. It is interesting to note that no gross anomaly of the mesentery was present.

On November 6, 1927, some six months after operation, she was re-admitted to the Children's Hospital extremely ill.

The history elicited was that she had been very well since the operation, but began vomiting two days before admission, being quite unable to retain anything, not even water. The bowels had been opened by enema two days previously. The mother had noticed a lump in the left side of the abdomen, which she thought had increased in size the following day. The baby had been breast fed, the breast feeding being supplemented occasionally. The child was shocked and practically moribund. Very little examination was possible, but the lump referred to by the mother was a large, tense swelling, tympanitic and gurgling on palpation. I thought that the child had sustained a twist of a universal mesentery and that obstruction was due to this. The chest, as far as examination permitted, seemed to be normal. I risked an abdominal incision under local anaesthesia, and found an extraordinarily dilated, tense stomach, which I

## Case II.

Frank B., a male, was first seen by me on October 19, 1927; he was aged three months. Up to six weeks of age this baby was normal. He then developed what the mother called "windy attacks" in which he caught his breath, became stiff with staring eyes, without loss of consciousness, and his colour would become black. His mother could "hear the wind roaring in him", but he never could bring it up. He had no vomiting at any time and no distension. These attacks occurred generally once a day, though occasionally he might not have one for a day or two. The attacks lasted from ten minutes to four hours, and during the longer ones he would have several convulsive seizures. The bowels were inclined to be loose at first up till eight or nine weeks old; they then became constipated, but on examination the stools were normal looking motions, about three a day. He had remained stationary in weight during this time, although sucking the breast well. He was a full time and an only child. An anæsthetic was given at the confinement, and the birth was easy without instruments. His weight at birth was 4.2 kilograms (nine and a half pounds), and was still the same.

There was some bulging of the chest wall anteriorly, but there was little difference in the percussion note on either side. Cardiac pulsation was present well to the right of the sternum, but not on the left side at all. This was confirmed by auscultation. The heart sounds were clear. Crackling sounds, obviously of intestinal origin, were heard as high as the third interspace on the left side. The left side of the chest was dull posteriorly, and the vesicular murmur was hardly audible here. A lump, thought to be either spleen or kidney, could be easily felt in the left hypochondrium, and the liver was two fingers' breadth below the costal margin on the right side. The urine examined was normal. The child was apparently normal otherwise. The mother had had a fall, comparatively mild, in the fifth month of pregnancy. The child was referred to the Children's Hospital with a diagnosis of diaphragmatic hernia, and this was confirmed by radiography (Figure III).

Operation was carried out on October 24, 1927. Under ether anæsthesia induced by the intratracheal method, I removed seven centimetres (two and three-quarter inches) of the ninth rib, and on opening the pleura I found the left side of the chest full of intestines, including part of the stomach, much small and most of the large bowel with the caecum and appendix. The diaphragm was not seen at first, and it seemed as if it were completely absent. I soon



FIGURE IV. Radiograph, Case II, after operation.

found, however, the medial part of the diaphragm, and then located a large opening easily admitting four fingers. The gut was reduced through this fairly easily, except for the hampering effect of the abdominal respiratory movements. I then saw the heart well over on the right side, the left lung being collapsed. The œsophagus appeared to be much dilated. It was now seen that the opening

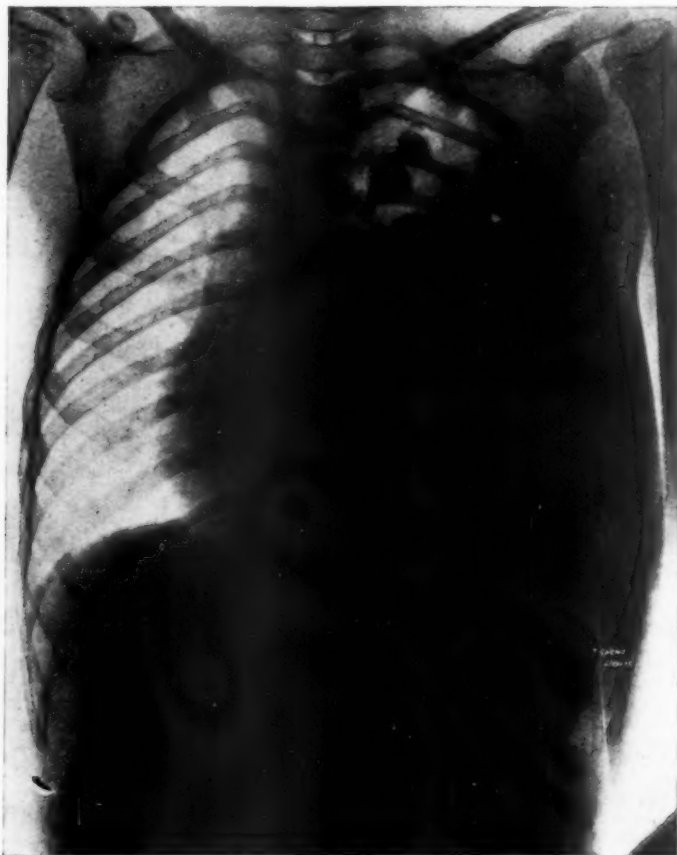


FIGURE V. Radiograph, Case III, before operation.

in the diaphragm was rounded, with the long axis running forward and to the left. It occupied the ventro-lateral area of the muscular part of the diaphragm and also part of the tendon, extending out as far as the diaphragmatic attachment to the chest wall. No peritoneal sac was present. The edges were freshened by splitting with the knife and the opening was sutured with chromicized gut sutures. The pleural cavity was then swabbed out, and the lung was gradually made to expand by increasing the intratracheal pressure. The external

opening was sewn up without drainage, four chromicized gut sutures embracing the ribs above and below being used. The skin was sutured with silkworm gut and horse-hair.

His after-history was uneventful. He lost 30 grammes (one ounce) in weight during the first ten days after operation, and gained 180 grammes (six ounces) in the succeeding ten days. He made an uninterrupted recovery, was discharged on November 19, 1927, four weeks after admission, and is now (six years later) a healthy, well-developed boy. Figure IV shows the radiological appearances after operation.

#### Case III.

Alan B., male, aged six years, was first seen by me on September 19, 1931. He was brought to me on account of "stomach trouble". For the past three



FIGURE VI. Radiograph, Case III, taken two months after operation.

or four months he had had attacks of vomiting and looseness of the bowels, mostly at night. Pain was also present when he walked. His appendix was removed at the age of three years, no drainage being necessary. He had had two sick turns before the appendix was removed. He had never been robust and always seemed tired. In the "turns" he was said to have become very flushed, to have vomited copiously once or twice, to have had right (and occasionally left) sided abdominal pain and four or five bowel actions daily. The attack would last two or three days, during which he would often belch most offensive gas. He had remained very thin since the appendiceal operation.

He was a full time infant, delivered without instruments under anaesthesia. His mother's pregnancy occurred after sixteen years of married life, being preceded by a premature stillborn child. His height was 109.6 centimetres (three

feet eight and one-quarter inches), his weight 17.7 kilograms (two stone eleven and a half pounds). There was definite diminution of vesicular murmur on the left side anteriorly, but fairly normal vesicular murmur at the left base. Borborygmi were noted as high as the left pulmonary apex. The percussion note on the left side was tympanitic. The cardiac apex was difficult to define, but appeared to be well over to the right side, to within 0.6 centimetre (one-quarter inch) of the right nipple. The sounds were obscured, but no bruits were audible. The liver dullness was not increased on the right side, spleen was not palpable, but the right kidney was palpable. The left side of the chest was slightly flatter than the right, and his back was rounded. At no time was any respiratory distress noticeable by the mother, but I elicited dyspnoea on slight exertion. The diagnosis of diaphragmatic hernia was made, and was confirmed radiographically (Figure V).

On October 3, 1931, under intratracheally induced anaesthesia, administered by Dr. Howden, I made an incision over the left eighth rib in the lateral plane,

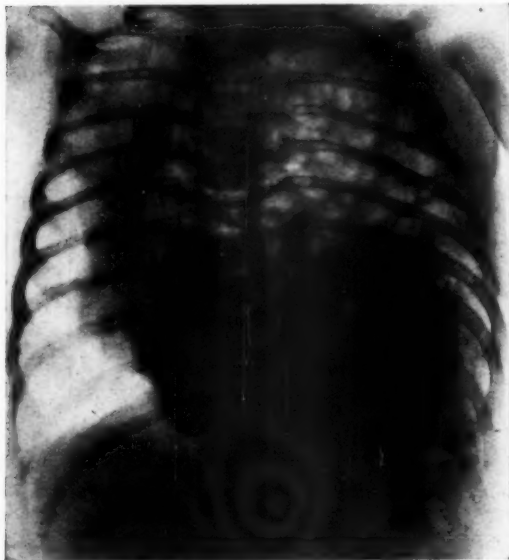


FIGURE VII. Radiograph, Case IV, showing intestines in thoracic cavity.

and removed 12.5 centimetres (five inches) of the rib subperiosteally. On opening the pleura the thorax was seen to be full of abdominal viscera, mostly small and large bowel, also an enlarged spleen, but not the stomach. In order to obtain more space for manipulation the seventh and ninth ribs were fractured. The opening in the diaphragm appeared to constrict the viscera, and was approximately 6.25 centimetres (two and a half inches) in diameter and situated laterally and posteriorly. It was necessary either to remove the spleen or to enlarge the opening in order to return it to the abdomen. The latter procedure proved successful, and after the spleen had been replaced, the intestines were with some difficulty also pushed into the abdomen. The heart was well over towards the right side and the left lung was collapsed and difficult to see, as it lay posteriorly near the spinal column. The diaphragmatic opening was then sutured with chromicized gut sutures. On increasing the intrapulmonary tension, portion of the lung expanded, but much at the base seemed atelectatic. The chest was sutured up completely without drainage. During the following three weeks the pneumothorax persisted, and a mild pyrexia associated with a small collection of fluid at the left base was present. On two occasions 20 cubic centimetres of blood-stained fluid were removed by aspiration, and on culture proved to be sterile. The patient was discharged from hospital on December 7, 1931, well; and a radiological examination at that time revealed an apparently normal thorax, with the heart in its proper position (Figure VI).

This boy has been seen and examined by me on several occasions since, and has developed into a healthy strong lad, apparently normal in every way.

#### Case IV.

Baby H., a female, eight days old, soon after birth, which was normal in every respect, appeared to have respiratory distress because of much mucus in



FIGURE VIII. Radiograph, Case V, showing stomach in hernial sac and its peculiar position.

the bronchi. On the fourth day she became cyanosed after each motion; these averaged five or six in the day. The attacks of cyanosis after each bowel action continued, but on the sixth day she became collapsed after each attack as well, and this state of affairs continued until the morning of the eighth day, when she died. Violent attacks of hiccups were also present during the last three days.

Radiography showed that the left side of the chest was filled with intestinal coils, and that the heart was pushed well to the right (Figure VII).



Autopsy was not obtainable, but radiography left no doubt as to the nature of the lesion.

**Case V.**

Leonard C. was a male, aged five years. As a contrast to the preceding cases, it is of interest to record the history and skiagrams of this boy, who



FIGURE IX. Radiograph, Case V, showing outline of the hernial sac.

had been treated for anæmia for two years, when an X ray examination revealed a diaphragmatic hernia. He was admitted to the Children's Hospital under Dr. Charles Osborn, to whom I am indebted for permission to use the skiagrams. The skiagrams showed in the right side of the thorax and above the liver near the mid-line posteriorly a clearly defined opacity with a rounded outline suggestive of a hydatid cyst. The hernia contained the whole of the stomach, the pylorus being close to the cardiac orifice, which was in a position corresponding to the normal œsophageal opening in the diaphragm. The stomach

itself was inverted so that the greater curvature was the higher in the thorax. (See Figures VIII and IX.)

At operation by the transthoracic route Dr. Osborn found a well defined peritoneal sac which contained stomach only, but which, owing to high intra-abdominal pressure, could not be adequately closed. At a later date he intends closing the opening by approaching it by the abdominal route.

#### Case VI.

John S., a male, aged one and a half years, was admitted to the Children's Hospital when five weeks old with a history of vomiting, sometimes projectile in nature, which had occurred after every feeding since a week after birth. The vomitus very rarely contained any bile. The bowels were not constipated, and on examination the liver edge was felt, but no tumour was detected in the abdomen. The baby then weighed 4.2 kilograms (nine pounds six ounces), having weighed 3.9 kilograms (eight pounds thirteen ounces) at birth.

The child was treated for a period of three weeks with belladonna without improvement as regards the vomiting. It then developed a cough which was aggravated by feeding and deglutition. The condition was regarded as either one of congenital pyloric stenosis or of a mild degree of congenital duodenal atresia. A barium meal was given, and X ray examination revealed a large amount of barium in the chest, which was at first thought to be due either to diaphragmatic hernia or to achalasia of the œsophagus. However, further examination revealed a stomach that was partly in the thorax and a congenitally short œsophagus (see Figure X).

A blood examination revealed no abnormality except an eosinophilia of 8%. The baby was full time and was breast fed, with supplementary cow's milk and water. It has been weaned now and is able to eat light baby diet and thickened milk foods, with, however, much coughing and vomiting. Its nutrition is poor; it now weighs 6.3 kilograms (fourteen pounds), and its bowels are frequently constipated, alternating with some diarrhoea, while at times mild hæmatemesis occurs.

This patient was exhibited recently at a meeting of the Pædiatric Society, Melbourne, by Dr. Tymms for Dr. Embelton, and I am indebted to these gentlemen

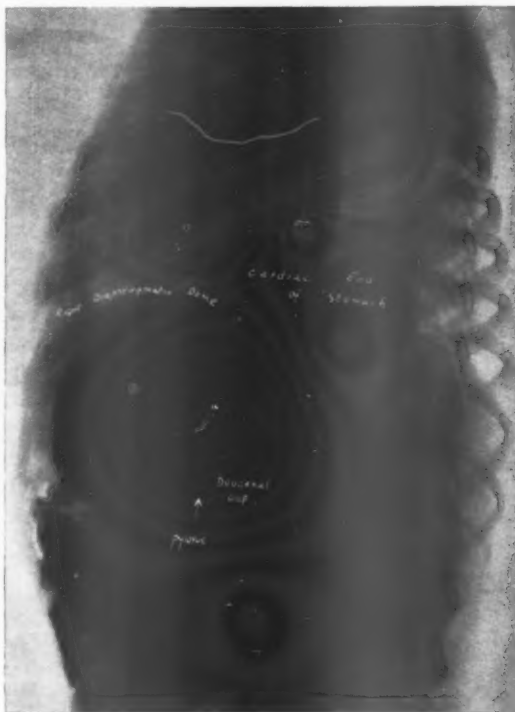


FIGURE X. Radiograph, Case VI, showing short œsophagus and thoracic stomach.


for permission to include it among this series of cases. It is a splendid example of short œsophagus and thoracic stomach. It was my intention to paralyse the diaphragm in this case, but the parents are reluctant to have any operative procedures carried out yet.

I have seen other cases of short œsophagus and thoracic stomach brought chiefly on account of alimentary and respiratory symptoms of obscure origin, and diagnosed by radiography. On account, however, of the fact that they are able to make slow progress without the supervision of catastrophic features necessitating operation during childhood, many such patients probably reach adult life before their condition is diagnosed.

The cases in this short series are of interest because they illustrate the fact that diaphragmatic hernia is comparatively frequently seen in childhood, that it has a definite clinical picture of its own, and that in some cases radical surgical measures are very successful. The importance of radiographic studies cannot be over-estimated, both from the point of view of diagnosis and for the pre-operative information of the surgeon, who is helped by knowing what to expect. It is probable that the routine use of radiography will lead to the discovery of more cases of this disease. In view of the various controversies that have raged as to the best method of surgical approach, it is important to note that in these congenital cases, at least, the thoracic approach proved so successful.

#### Acknowledgements.

I am deeply indebted to my colleagues at the Children's Hospital, Melbourne, and others, for their courtesy in giving me permission to use their case histories. I wish especially to mention Dr. Grieve, Dr. Osborn, Dr. Embelton, Dr. Graham, Dr. Hewlett, Dr. Macdonald, Dr. O'Sullivan, Dr. Webster, Dr. Paton, Dr. O'Collins, Dr. Brown, Dr. Howden and Dr. Tymms.



## DIAPHRAGMATIC HERNIA IN ADULTS: A CASE OF TRAUMATIC DIAPHRAGMATIC HERNIA.

By W. A. HAILES,  
*Melbourne.*

A.R., a MALE, and a pastry-cook by occupation, was admitted to the Melbourne Hospital on February 11, 1930. In 1915 he had received a shrapnel wound of the left side of the chest. He had had no disability from this, except that he



FIGURE I. Radiograph after barium enema before operation, showing constriction at opening of hernial sac, large diaphragmatic hernia containing coils of large intestine and lateral entero-anastomosis.

always appeared to breathe more with the right side of the chest than with the left. In March, 1929, he suffered from intestinal obstruction, and was operated on by another surgeon, who found that a left-sided diaphragmatic hernia was the cause of the obstruction. An anastomosis between the transverse colon and descending colon was then carried out, and the patient remained well till three weeks before I saw him. At that time he felt something give way in his back

and following that fainted several times, an entirely new experience for him. It was because of this pain that he came to hospital for advice.

A barium enema, carried out on February 7, 1930, while he was an out-patient, revealed that the colon filled to the caecum without delay, that there was a large diaphragmatic hernia on the left side, the pleural sac being nearly filled with coils of large intestine. A narrow anastomosis between the transverse and descending colon was visualized, and both proximal colon and that portion in the hernia emptied well after evacuation (Figure 1).

In spite of an efficient evacuation after the barium enema the patient experienced colicky abdominal pain associated with vomiting, which was so persistent that he was regarded as possibly suffering from an obstructed hernia, and was admitted to hospital.

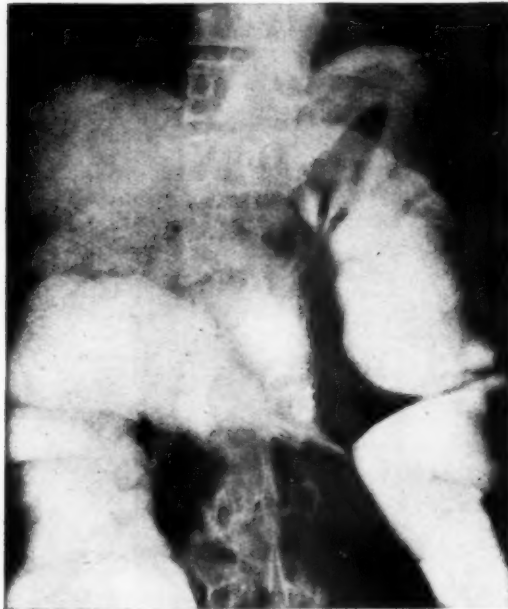


FIGURE II. Radiograph, after operation, of barium enema, showing absence of diaphragmatic herniation.

Examination revealed his temperature to be  $36.1^{\circ}\text{C}$ . ( $97^{\circ}\text{F}$ .). His pulse, which was regular but of poor tension, had a rate of 76, his systolic blood pressure was 130, and his diastolic pressure 100 millimetres of mercury. The apex beat of the heart was not palpable, the left cardiac dulness was absent and the cardiac sounds were audible only when the patient leaned forward. The left side of the thorax moved less than the right, there was a hyper-resonant percussion note over the left side anteriorly and in the axilla. The breath sounds were easily elicited over the right lung, but were diminished at the left apex, the same sounds being barely audible at the left base and in the left axilla. The abdomen was not distended, nor was there any tenderness. The patient was given a high turpentine enema with a good result, and had his bowel washed out every day for four days till February 16, 1930.

Operation was performed on February 17, 1930. Under intratracheally induced ether anaesthesia a long incision was made over the left eighth rib, and about 20 centimetres (eight inches) of rib were resected. The pleural cavity was widely opened, the transverse colon being found distended with gas, so that it almost completely filled the left pleural cavity. It was also adherent to the pericardium and to the pleura, especially around the root of the lung and at the hernial orifice. The adhesions were divided and ligated and the hernial orifice, which was about 3.75 to 5.0 centimetres (one and a half to two inches) in diameter, was clearly defined. This was then enlarged, the bowel was freed and returned into the abdominal cavity. The hernial orifice was closed with mattress sutures of chromicized gut and oversewn with interrupted chromicized gut sutures. The


pleural cavity was then closed without drainage. A blood transfusion was necessary to control the shock, but otherwise convalescence was uneventful.

On March 20, 1930, a barium enema showed that the splenic flexure was lying completely beneath the left half of the diaphragm (Figure II).

Examination with the screen revealed a little opacity at the left base, with a very small effusion in left costophrenic angle, but the left lung was well expanded.

The patient remained well for two years, when he became affected by pulmonary tuberculosis, for which he was treated at the Melbourne Hospital. He had then, clinically or radiographically, no evidence of recurrence of the hernia. An interesting point arose in regard to the causation of the hernia, as there was only one wound scar on the body, over the left ribs posteriorly, and no foreign body was revealed by X ray examination. This raised the question of the foreign body having entered the stomach or colon with natural evacuation. The other alternative was that the wound was actually a non-penetrating one, the lesion in the diaphragm being due to concussion or tearing, both of which, of course, are well recognized as a cause of such hernia.

There could be only one debatable point in regard to treatment, namely, the method of approach. Although the consensus of opinion in the literature at that time appeared to favour an abdominal approach, it was felt that this referred more to congenital cases around the oesophageal opening. In the case of a large traumatic diaphragmatic hernia with extensive adhesions which were certain to be present after the inevitable hæmothorax at the time of the wound, the thoracic approach seemed not only indicated, but the only one that could adequately expose the herniated bowel and adhesions. The operation, while formidable, was not beset with great difficulties, as the exposure proved adequate and the closure of the diaphragm, which might be difficult with a large opening, was relatively easily effected. In addition, there was apparently little pleural effusion after the operation because, although a close watch was kept, there was never enough dulness to warrant aspiration or exploration. This was also confirmed radiographically later. Crushing of the phrenic nerve as a preliminary to operation was debated, but was considered unnecessary.



## DIAPHRAGMATIC HERNIA WITH OBSTRUCTING SYMPTOMS.

By H. K. PAVY,

*Naracoorte.*

ALTHOUGH very many cases of diaphragmatic hernia have been reported in recent years, the following case of intestinal obstruction as the result of a severe fall in a man with this lesion, seems of sufficient interest to report in some detail.

F.F.C., a male, aged twenty-four years, was admitted to hospital on June 21, 1930, with the signs and symptoms of acute intestinal obstruction. He had had acute upper abdominal colicky pain of three days' duration, which had gradually increased in severity. He had vomited bile-stained fluid twenty-four hours after the onset of pain, and there was complete constipation and anorexia.

Six months previously he had been thrown out of a side-car, and, although he had a heavy fall, he escaped with a few bruises and abrasions. Prior to his accident he had been very healthy and well, and there was no history of digestive, respiratory or cardiac distress at any time. During the six months between his accident and his admission to hospital he had had about five attacks of fairly acute pain in the upper left part of his abdomen and epigastrium. These attacks would last from half an hour to two hours, and on two occasions he had vomited during the attacks, but he had not consulted a doctor about them.

On examination he appeared very ill and distressed. His eyes were sunken, his tongue was dry and heavily coated, and he lay doubled up on his right side in obvious pain. His temperature, pulse rate and respirations were practically normal. The apex beat was not palpable, but the heart sounds were clear and regular. On percussing his chest and abdomen it was found that the left side of his chest was tympanitic, and that this note was continuous from the third left costal space downwards over the anterior chest wall and abdomen. The breath sounds were distant. Posteriorly the chest appeared normal, and no displacement of the heart was noticed. The abdomen moved freely with respiration, was slightly distended, and was a little more resistant over the upper part.

Two bowel washings were returned clear. Twelve hours later the abdomen was greatly distended, and the tympanitic note more marked. An injection of one cubic centimetre of pituitrin and a bowel wash-out resulted in the passage of a large amount of flatus and thin slate-coloured, extremely offensive motion, with relief of the pain and distension.

By June 25 he was feeling much better, the distension had subsided, his tongue was cleaning, and his motions were practically normal. He was then given a barium enema. The barium filled the rectum and ran straight up the left side to the level of the fourth rib, and then turned downwards to the level of the diaphragm. The diaphragm could not be seen on the screen. When he stood up, the loop of bowel above the level of the diaphragm emptied, and he was then given a barium meal. The meal passed down the œsophagus to the level of the diaphragm normally and then turned to the left and ran upwards, filling a stomach, the whole of which appeared above the diaphragm. The loop of colon was behind the stomach in the chest, and the heart was displaced a little to the right (Figure 1).

Two days later the left phrenic nerve was exposed in the neck and injected with alcohol. On June 30 laparotomy was performed. The left half of the diaphragm was flaccid, and a defect was found in the dome of the diaphragm, extending backwards and to the left from the region of the œsophageal opening.



It easily admitted four fingers. The edges were thick and fibrous. The whole of the stomach and transverse colon and many coils of small intestine had passed through the opening and were lying in the thorax. The spleen was under the diaphragm, but was displaced towards the mid-line. No adhesions were present. Closure of the defect was found to be impossible, owing to the difficulty in controlling and returning the herniated contents into the abdomen, the inaccessibility of the defect from an abdominal approach, and the patient's serious condition.

One month later, when he was preparing to leave hospital, he had another sudden attack of abdominal pain, distension and vomiting. It was at this stage that he came under my care. Medical treatment completely relieved his symptoms. His subsequent history is that he had three more acute attacks of pain during the next few months. Each attack was promptly terminated by giving morphine hydrochloride 0.03 gramme (half a grain) and atropine sulphate 0.43 milligramme (one one-hundred-and-fiftieth of a grain). For the past three years he has remained very well, and is carrying on with his usual work.

His present health is excellent. His chest, on percussion and auscultation, gives practically no indication of the presence of so large a hernia. The heart is very slightly displaced to the right (Figure II).

On February 26, 1934, he was given a barium meal, which showed that all the stomach, with the

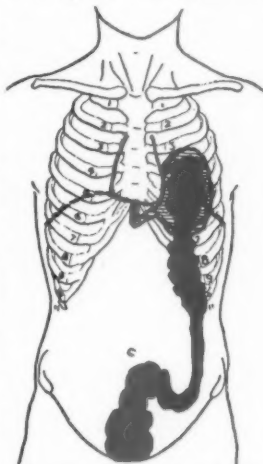


FIGURE I. Showing position of stomach and colon, July, 1931.



FIGURE II. Showing surface marking of stomach after a full meal, March, 1934.

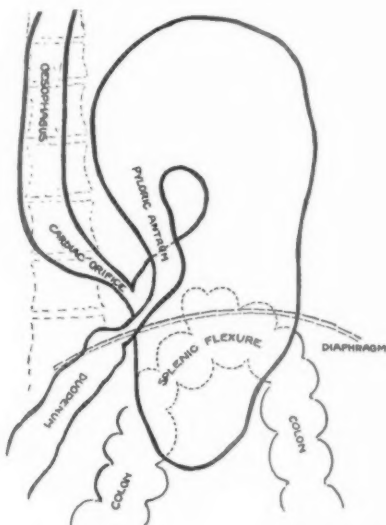


FIGURE III. Tracing of barium meal showing arrangement of stomach, February, 1934.

exception of a portion of the fundus, was in the thorax. The stomach was bent on itself as represented in Figure III, so that the pylorus was very close to, and apparently in front of, the cardiac orifice (Figure IV).

In the erect position only a small segment of the splenic flexure appeared to be above the diaphragm. In the supine position, with the feet elevated, a large loop of the colon entered the thorax posterior to the stomach (Figure V).



FIGURE IV. Radiograph showing large stomach with barium in the pyloric antrum, the fundus being empty. A small duodenal cap appears opposite the eleventh vertebra, and the splenic flexure is situated posteriorly. Patient prone, feet elevated.

Two other interesting points were revealed on examination under the screen. Firstly, the whole colon was exceptionally mobile, the caecum and ascending colon being easily pushed across to the left side; and, secondly, despite this unusual mobility, the position of the remainder of the colon, with the exception of the high splenic flexure, was normal.

It is probable that this case was one in which an intestinal obstruction was caused in a large diaphragmatic hernia as the result of an accident which altered the arrangement or the volume of the herniated structures. It presents several interesting features apart from the onset of the obstruction:

1. The long symptomless period of twenty-four years, then an eventful twelve months following his accident, followed by three years of normal life, is unusual.

2. When the patient was examined in 1930 the contents of the hernia remained constant. At his recent examination it was found that, while the stomach remained in the same position, the colon entered the thorax freely when the patient was supine, and returned to the abdomen when erect.

3. It emphasizes the difficulty of dealing with a defect of the dome of the diaphragm using an abdominal approach. As the obstructive symptoms had subsided, it would appear that a thoracic approach would have been advisable.

4. One of the most remarkable features is the almost complete absence of any signs in the chest at the present time, despite the large size of the hernia.

The diagnosis of the cause of the obstruction in this case was fairly obvious, and this was readily confirmed by the radiological examination. Bryce and Gray<sup>(1)</sup> have reported a case in a boy of seven years, in whom symptoms developed after a fall from a bicycle. In their case the barium meal examination revealed no

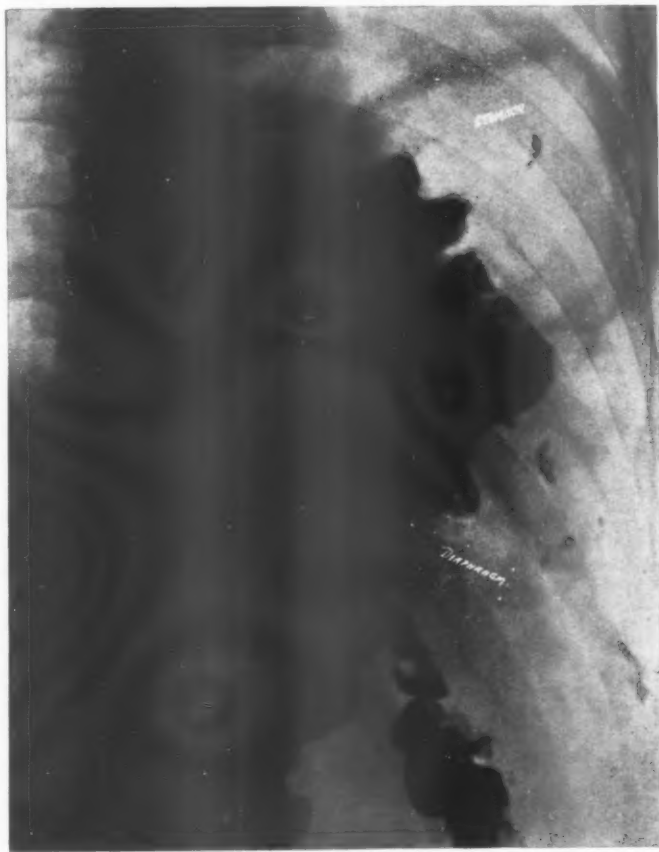


FIGURE V. Radiograph with patient supine and feet elevated, showing the splenic flexure above the diaphragm.

abnormality and, at operation, only the spleen was found in the hernial sac. In certain sites, and especially when only a small defect is present, the true cause of the obstruction could be easily overlooked, unless a careful radiological examination were undertaken, with the possibility of a diaphragmatic hernia in mind.

From a review of the literature, hernia or defects in the diaphragm are being found comparatively frequently. This is due to improved radiological technique,

and to a greater realization of their frequency. Dickson<sup>(3)</sup> has reported 206 cases from the Radiological Department of the Toronto General Hospital, diagnosed during the last fourteen years. This represents approximately one in every hundred routine gastro-intestinal tract examinations.

The aetiological factors, as well as the anatomy and pathology of the various types of diaphragmatic hernia, have been very adequately described by Hume<sup>(2)</sup> in the Hunterian Lecture of 1931, and Keith<sup>(4)</sup> published an analysis of the anatomical findings in thirty-three London museum specimens in 1914.

The treatment of cases of diaphragmatic hernia with obstructive symptoms will always present a problem to the surgeon, especially in deciding the proper method of approach. An accurate localization of the defect is necessary, but is only possible if the patient's condition will permit a careful radiological investigation. If the herniation is through the foramen of Morgagni or the oesophageal opening, most writers are agreed that a laparotomy is the operation of choice. With symptoms of acute obstruction the relief of the bowel is the essential point, and here a laparotomy is the best method of attack. When the picture is one of partial or chronic obstruction, Hedblom<sup>(5)</sup> advises a carefully planned thoracotomy under intratracheally induced anaesthesia. He condemns the operation of combined thoraco-laparotomy. In arriving at his conclusions he presents a review of 1,003 cases reported between 1900 and 1931. Harrington,<sup>(6)</sup> who reports a series of 60 cases operated on at the Mayo Clinic, favours laparotomy in all cases of diaphragmatic hernia, unless there are definite indications for thoracotomy.

In all cases it is the consensus of opinion that a preliminary paralysis of the phrenic nerve should be performed.

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## SUDDEN DEATH IN UNRECOGNIZED DIAPHRAGMATIC HERNIA.

By IAN HAMILTON,  
*Adelaide.*

It is thought that the record of the following case might be of interest, not only from the forensic point of view, but also from the clinical.

A male, aged sixteen and a half years, had for some months previously suffered for a short period from mild dyspeptic attacks. These had been relieved by some medicine which the family doctor had given him. He was quite well and appeared normal on the morning of January 29, 1934, when he left home to attend a picnic. On the way to the picnic he ate some sandwiches, and as it was a very hot day indulged in a drink of aerated lemonade. Almost immediately he experienced a severe pain in the stomach, but this passed off after a short time. Later in the day he took some more "soft" drinks, and almost immediately after appeared to be in such distress that a friend drove him home about 3.30 p.m. His father stated that on arrival home he complained of terrible pains in the stomach. The family doctor was called and gave him some morphine. At a result he went to sleep, and four hours later the doctor saw him and said he was much better. The boy said that he still felt very sick, but that he could only dry retch. If he took a drink of water it came back quite clear in a minute or even less. At 10 p.m. he was restless and tossed about in bed, but did not complain of much pain. At 11 p.m. he went to the lavatory, and the following is best told in the father's words: "When he returned, I heard a noise, went out and he was lying on the floor. I carried him to the bedroom, and stood him on his feet, and he said 'Where am I?' and then collapsed in my arms. I sent for the doctor, who came about a quarter of an hour later and found that my son was dead."


An inquest was ordered, and in accordance with the Adelaide City Coroner's instructions I carried out a *post mortem* examination on January 31, 1934. The autopsy findings were as follows:

The body was that of a well nourished adolescent male, there being no signs of injury except a small abrasion, possibly produced by the fall, on each elbow. There was some *post mortem* staining and *rigor mortis* was present. The intestines were distended, but the stomach and spleen were absent from the abdominal cavity. The stomach and spleen were lying along with a loop of the transverse colon in the left half of the thorax. The stomach was very distended, and had caused bulging of the left side of the diaphragm caudally into the abdomen, so that it resembled a large tense rubber ball about 15.0 centimetres (six inches) in diameter. The stomach contained milky fluid and mucus and a large amount of gas. The lesser curvature of the stomach was very congested, while the loop of large intestine was kinked with distension above and collapsed below the kink. The spleen was pale, soft and somewhat flattened, but lay entirely within the thorax. The right lung appeared normal, but the left lung was very small; the heart was displaced to the right of the mid-line. The heart muscle was very soft and pale and the ventricles contained dark fluid blood. There was no valvular disease and no sign of embolism in the pulmonary arteries. There was a large opening 5.0 centimetres (two inches) in diameter, in the dome of the diaphragm, 5.0 centimetres to the left of the oesophageal opening, through which the herniation had taken place. The liver was normal in colour and texture, and was displaced

somewhat to the right, the left lobe being a little smaller than normal. The small intestines showed congestion as well as distension, but no obstruction was detected. The kidneys were engorged with blood, dark red in colour, the suprarenals appearing normal. Examination of the œsophagus, trachea, larynx, thyroid, tongue, brain, bladder and testicle revealed no abnormality.

It was considered that death was due to shock and asphyxia, induced by over-distension of a thoracic stomach, probably due to sudden distension with secondary block of both cardiac and pyloric orifices.

The case is of some interest in that it illustrates a possibly fatal complication of this type of hernia.



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## LOBECTOMY FOR BRONCHIECTASIS.

By C. J. OFFICER BROWN AND C. A. MARSHALL RENOU.

[From the Alfred Hospital, Melbourne.]

D.W., AGED nineteen years, was admitted to the Alfred Hospital on September 10, 1934, and discharged on December 28, 1934.

She had had a persistent cough for five years, with an increasing amount of very foul sputum and occasional small hæmoptyses. Her general condition was excellent and she was afebrile. The condition followed an attack of influenza.



FIGURE I. Antero-posterior radiogram after lipiodol filling, showing cavitation at left base and very early tubular bronchiectasis at right base.



FIGURE II. Lateral radiogram after lipiodol filling, showing cavitation at left base.

On examination she had definite clubbing of the fingers. At the base of the left lung the percussion note was impaired, breath sounds and vocal resonance were diminished, and there were many râles and rhonchi.

At the base of the right lung there were some moist sounds. Each day she coughed up 270 to 300 cubic centimetres (nine to ten ounces) of very foul sputum. Smears showed no tubercle bacilli and on culture staphylococci and streptococci were grown.

X ray examination of her lungs after lipiodol filling revealed gross bronchiectasis of the left lower lobe and very early tubular bronchiectasis in the right lower lobe (see Figures I and II).

In 1930-1931 treatment was directed towards the elimination of nasopharyngeal sepsis, and on April 10, 1931, phrenic exeresis was performed; it was followed by the induction of artificial pneumothorax, which was maintained for about eight months (see Figure III). During 1933-1934 bronchoscopic aspiration of secretion was performed at weekly intervals. Postural drainage was practised for most of the period between 1930 and 1934.



On September 25, 1934, a one-stage lobectomy was performed. Pre-operative pneumothorax, although desirable, was not attempted in this case in view of the certainty of adhesions.

A preliminary injection of 0.015 gramme (one-quarter of a grain) of morphine was given one hour before operation, and in the theatre the pharynx was sprayed



FIGURE III. Radiogram showing the amount of collapse obtained by therapeutic pneumothorax in 1931.

with 3% "Pantocain" solution and then 10 cubic centimetres of "Evipan" were injected into the median basilic vein. Unconsciousness immediately followed the injection of "Evipan", and Dr. Athol Blaubaum passed a bronchoscope and aspirated 10 ounces of foul pus from the left lower lobe of the lung.

A large bore rubber intratracheal tube and a gum elastic catheter were then passed into the trachea, and nitrous oxide was administered by Dr. Douglas Renton before the effect of the "Evipan" had worn off, and the patient was then placed on the right side with the head low. The gum elastic catheter was used for intermittent suction during operation.

A long incision was made in the seventh interspace, with section of the posterior ends of the seventh and eighth ribs. Haemostasis was secured by diathermic coagulation. Adhesions were extensive and dense, but stripped without difficulty or bleeding. Two pedicle clamps (Figure IV) were used, and the stump was closed by Shenstone's<sup>(1)</sup> suture

method. One branch of the pulmonary artery was missed by the suture and escaped on loosening the clamp, resulting in the loss of about 300 cubic centimetres (10 ounces) of blood and fifteen minutes of operating time.

Drainage was through a stab in the eighth space, and the wound was closed by pericostal and muscular catgut sutures and skin sutures. The operating time was 65 minutes.

Signs of shock appeared rapidly after the loss of blood from the pedicle, and a blood transfusion was given immediately after operation. The patient's

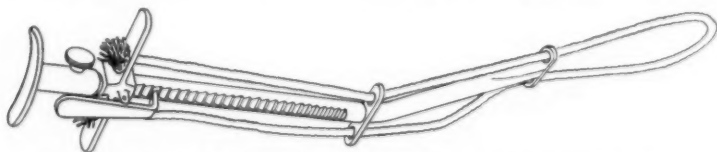


FIGURE IV. Author's lung tourniquet. The instrument measures 23.75 centimetres (nine and a half inches) in length, and is very simply threaded, and, if necessary, the cord can be unthreaded on one side and passed round the pedicle and rethreaded, as in retrograde lobectomy, without loss of time. In use the cord is pulled up until the loop is just tight around the pedicle, and then knotted over the cross-piece. Tension of the cord is then obtained by means of a slide and ratchet.

condition remained poor for twelve hours, but then rapidly improved. She was placed in Fowler's position, with a water seal negative pressure drain. Serousanguinous fluid drained freely from the start.

On the fifth day an empyema was diagnosed by X ray examination and exploratory puncture, and on the sixth day a de Pezzer catheter was inserted

in the sixth space in the mid-axillary line by means of a trocar and cannula under gas and oxygen anaesthesia and attached to a second water seal suction bottle. The patient's condition rapidly improved, and her only complaint was pain round the original drainage tube, which was relieved by its removal on the fourteenth day. The de Pezzer catheter was retained till the twenty-first day. Pus from the empyema was very foul, but sputum after operation was odourless.

Progressive X ray examination showed reexpansion of the lung up till the twenty-third day. X ray examination on the twenty-seventh day showed less expansion.

A bronchial fistula developed some time in the second or third week, and a sinus with a slight amount of discharge persisted until about the ninetieth day. During this period the patient had an intermittent temperature, but was otherwise well. Lipiodol injection of the sinus on the eighty-seventh day showed a narrow track with a bronchial opening, and lipiodol was expectorated after five cubic centimetres had been injected.

The patient was discharged from hospital on December 28, 1924, with the wound healed and afebrile, and has had no further trouble with the wound. Since the day of operation sputum has been odourless, and since the early post-operative period has averaged 30 to 60 cubic centimetres (one to two ounces) daily.

Bronchoscopy on the eighty-second day showed that the velvety inflamed bronchial mucosa had returned to a practically normal appearance.

Unfortunately X ray examination of the right lung after lipiodol filling showed some advance of the early bronchiectasis in the right lower lobe (Figure V). This would appear to be the source of the persistent sputum.

#### Comment.

Influenza appears to have been the aetiological factor in this case, and is recognized as a common cause of bronchiectasis. Persistent cough with sputum following influenza should indicate the need for investigation of the nasal sinuses, and the earlier use of the bronchoscope would lessen the incidence of serious cases of bronchiectasis.

The odour of her breath made social life of any kind impossible for our patient. Intravenous arsenical injections are said to control this to some extent. Lobectomy relieved it at once.

Bronchoscopic aspiration at weekly intervals gave our patient great relief and improved her general condition in a remarkable way. Cough and sputum were practically abolished for forty-eight hours, and then returned and gradually increased until the next aspiration.

This measure is only palliative, except possibly in the earliest cases, and the risk of drug addiction consequent on the weekly use of morphine and cocaine must be very real.

Phrenic exeresis and artificial pneumothorax were of no value in this case. X ray examination after lipiodol filling showed very little collapse of the cavities, despite considerable collapse of the lung.

The cavities were completely lined by epithelium, so that no method of compression was likely to cause their obliteration, and the tough fibrous lobe would resist collapse, except at considerable pressure. For this reason and on account of adhesions, phrenic exeresis and pneumothorax do not appear to be



FIGURE V. Post-operative radiogram after lipiodol filling to show the advance in the bronchiectasis at the right base.

of much value except in very early cases. Even when it relieves symptoms, pneumothorax must be maintained or replaced by oleothorax or thoracoplasty or the symptoms will return. Thoracoplasty has succeeded in a few cases, but there are many failures. Very extensive rib resection is necessary to cause collapse of the diseased lobe, and the normal lobes are sacrificed with the diseased one. Deformity is marked, and the method should be reserved for cases in which the whole of one lung is involved.

Hedblom<sup>(2)</sup> in 1930 reported thirty-two cases of thoracoplasty with four early post-operative deaths and seven deaths later from complications or further operation. Three patients were completely relieved of symptoms, and the remaining eighteen patients were improved to a greater or less extent.

Total pneumectomy has been successfully performed on a few occasions for bronchiectasis of the whole lung.

Lobectomy promises a complete cure if the disease is sufficiently localized for removal of all diseased tissue.

Previous phrenic exeresis and prolonged pneumothorax militate against successful lobectomy. Rapid expansion of the remaining lobes is one of the most important factors for success, and paralysis of the diaphragm removes the principal factor in expanding the lung. Prolonged artificial pneumothorax causes thickening of the pleura and adhesions which interfere greatly with the capacity of the remaining lobe to fill the hemithorax. Both these factors were evident in our case.

Tudor Edwards<sup>(3)</sup> has reported fifty-seven lobectomies for bronchiectasis with eight deaths, giving a total mortality of 14%. Seven of the first forty-eight patients died. Thirty-five are virtually symptomless, and six have residual symptoms of slight degree compared with their original condition.

Jex-Blake,<sup>(4)</sup> in a series of one hundred and eight autopsies in cases of bronchiectasis, found that the disease was unilateral in sixty-one and unilobular in thirty-four, so that nearly one case in three should be suitable for lobectomy.

Graham's cautery lobectomy provides very efficient drainage, and is a valuable method for dealing with chronic lung abscesses with marked toxæmia. For bronchiectasis it should be considered only when lobectomy is impossible or forbidden by the patient's condition.

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- <sup>(2)</sup> Carl H. Hedblom: "Pathogenesis, Diagnosis and Treatment of Bronchiectasis", *Surgery, Gynecology and Obstetrics*, Volume III, February, 1931, page 406.
- <sup>(3)</sup> A. Tudor Edwards and C. Price Thomas: "One Stage Lobectomy for Bronchiectasis: An Account of Forty-eight Cases", *The British Journal of Surgery*, Volume xxii, October, 1934, page 310.
- <sup>(4)</sup> A. J. Jex-Blake: "Bronchiectasis", *The British Medical Journal*, May, 1920, page 591.

## CERVICAL ŒSOPHAGECTOMY FOR CARCINOMA.

By SIR HENRY NEWLAND,

*Adelaide.*

In this account is given the record of the successful removal of a carcinoma of the œsophagus, and of the operation of secondary œsophagoplasty performed three and a half months later; the œsophagoplasty ended fatally.

In the majority of instances carcinoma invades the thoracic portion of the œsophagus, and operations for the removal of such growths have in recent times taxed the inventiveness of surgeons. Successful removal of carcinomatous growths in the thoracic portions of the tube has been recorded by Zaaier, Torek, Eggers and Grey Turner.

The operation of cervical œsophagectomy for carcinoma was first performed by Czerny in 1873. In this case the upper end of the lower segment of the œsophagus was fixed to the margins of the skin wound, and the patient was fed by means of a tube. Quervain collected 15 cases of cervical œsophagectomy, which include the patients operated on by Czerny, Mikulicz and Garre. The field of this severe operation is, as Rigby remarks, a limited one. It is applicable only to small growths in the upper end of the œsophagus.

For some unexplained reason carcinoma of the upper third of the œsophagus is more frequently met with in women. Writers agree that the upper third is the part of the œsophagus least frequently affected, only 10% to 15% of the cases occurring there. When it does affect the upper third, carcinoma is far more common at the proximal end and consequently is very apt to involve the larynx and thyreoid gland. These features explain the paucity of cases suitable for operative removal.

The cervical œsophagus is only 6.25 to 7.5 centimetres (two and a half to three inches) long; consequently the growth must be a limited one if enough of this segment of the œsophagus is to be available above and accessible below, after the excision of the growth, to permit of the restoration of the continuity of the tube by œsophagoplasty.

The risks of infection after operation are great; the mortality is estimated at 35%. Direct primary axial union of the divided ends after excision of the growth is almost invariably impossible. The excised portion has been restored by secondary œsophagoplasty, a tube of skin being made from a skin flap from the neck; or the upper end is fixed to the skin and later connected with the gastrostomy opening or, if occasion offers, with the lower segment of the œsophagus.

Reference to the year books of the last few years proves them to be singularly devoid of cases of resection of the cervical œsophagus for carcinoma, and affords a reason for recording the following case.

Miss E.D.S., aged forty-three, a spare and delicate woman, was first seen in March, 1934, by Dr. Guy Lendon, with whom I later on saw the patient in consultation. Her main complaints were dysphagia and dyspnœa. On examination she was found to have anæmia, an atrophic tongue and mitral stenosis. The right lower extremity was wasted and shortened as the result of an old infantile paralysis, and a marked scoliosis was present. A month later she reported that fluid sometimes regurgitated through her nose. A screen examination with X rays revealed no abnormality. The anæmia had improved with iron. Towards the end of May she complained that meat stuck in her throat, and she then admitted that this had happened on several occasions during the last eighteen months. She was again examined with X rays, and currants rolled in bismuth powder were given to her to swallow. These were found to stick high

up in the œsophagus about 6.25 centimetres (two and a half inches) below the hyoid bone. Dr. Glynn was able to see the obstruction through the œsophagoscope. A small portion of the growth was removed by him and showed the structure of a squamous carcinoma.

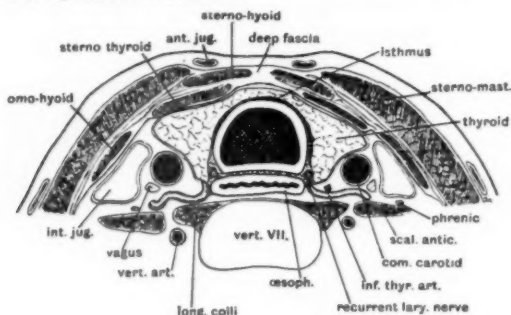


FIGURE I. Section of the neck showing the relative position of the main contents of the inferior carotid triangles.

As the dysphagia was becoming much more pronounced, and the weight had fallen to 37.8 kilograms (six stone), a gastrostomy was performed on June 8. Three weeks later the weight had increased by 1.8 kilograms (four pounds). In the meantime an enlarged gland had appeared in the left axilla. It was removed under local anaesthesia, but showed no sign of malignant disease. It

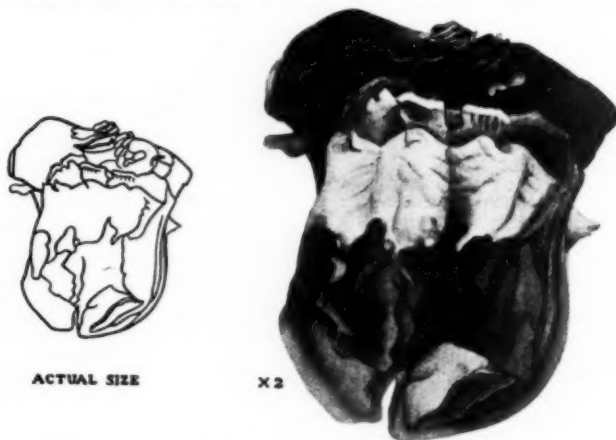


FIGURE II. The œsophagus laid open to show the growth after resection.

was decided to defer no longer the attempt to remove the growth. On July 4, Dr. Gilbert Brown gave ether by the intratracheal method. An incision was made in the orthodox manner along the anterior border of the left sterno-mastoid muscle (Figure I), which was partly divided above the clavicle to gain more room. The omohyoid muscle was also divided and the inferior thyroid

artery was ligated. The growth was easily exposed, and its upper and lower limits were defined. As removal seemed feasible, it was freed on its left and anterior and posterior aspects. It was then found to have extended and to have become adherent on the right side of the neck. To overcome the difficulty of removal it was found necessary to make a similar incision on the right side of the neck. The extension of the growth was then found to be due to two lymphatic glands having become involved. These were dissected away from the carotid sheath and from the lower pole of the left lobe of the thyroid gland. The growth was then easily drawn into the incision on the left side of the neck

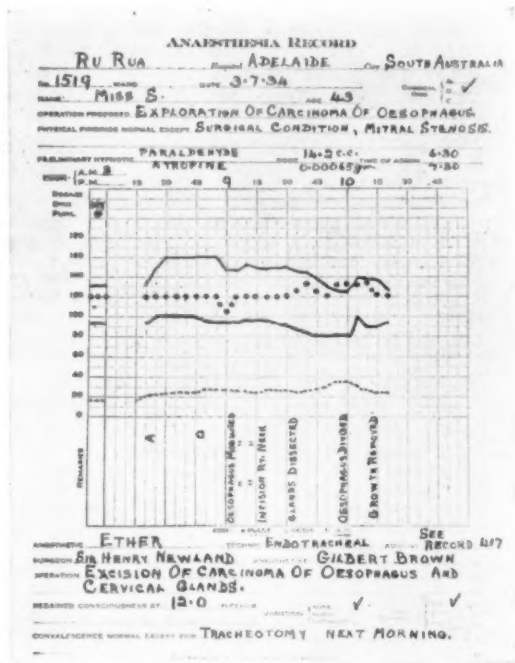


FIGURE III. Anæsthesia record.

and removed (Figure II). The open end of the upper segment of the œsophagus was sutured to the skin. The lower end was ligated and the stump was sutured with catgut to the edges of the divided sterno-mastoid muscle. It was not possible to attach it to the skin. Iodoform gauze was packed loosely around it and the lower part of the incision was left open. The incision on the right side of the neck was closed.

Notwithstanding the severity of the operation, the blood pressure was little influenced, though the pulse rate was rapid throughout (Figure III).

When seen the same evening, the patient was much troubled by mucus collecting in the throat; she was a little irrational and tried to remove the dressing from the neck. She was given ice to suck and 1.3 milligrammes (one-fiftieth of a grain) of atropine was injected. Next morning the patient's distress

had increased; much mucus still collected in the larynx, and she was becoming cyanosed. It was decided to do tracheotomy, and while preparations were being made for the operation oxygen was given.

The tracheotomy was carried out under local anaesthesia and at once gave relief. For some days, however, the patient continued to cough up quantities of muco-pus, was desperately ill and at times semiconscious. Matters had taken a more favourable turn, when the patient developed a pleurisy with an effusion a fortnight after the operation, and Dr. Guy Lendon aspirated half a pint of serous fluid. Convalescence proceeded slowly. It was not found practicable to remove the tracheotomy tube until a month after its introduction. The patient was well enough to return home on August 14, her weight being 34.8 kilograms (five stone seven and a half pounds). Feeding through the gastrostomy tube having become distasteful to her, the problem of restoring the continuity of the oesophagus by means of a plastic operation was discussed with the patient. She desired the attempt to be made, and two months after having left the hospital she returned to it again. In the meantime she had gained 1.3 kilograms (three pounds) in weight.

Ether was given with the Shipway apparatus. In order to facilitate the finding of the upper end of the lower segment of the oesophagus, which had retracted as the original incision in the neck had healed, an attempt was made to pass an oesophageal bougie via the gastrostomy opening. This turned out to be a difficult procedure and much valuable time was wasted before this was achieved, and it was achieved only after the gastrostomy opening had been incised and enlarged. An olivary headed metal bougie with a flexible shaft was used. Even with this as a guide it was not easy to define the upper end of the oesophagus, which in the process of healing had retracted between the carotid artery and the trachea. To aid in the exposure and the subsequent plastic procedure the inner half of the clavicle was removed. The oesophageal stump having been reopened, a flap of skin with its attachment above was cut from the left side of the neck. The flap was converted into a tube and sutured to the open end of the oesophagus. This junction and the cutaneous tube were covered with a flap of skin cut from the left pectoral region.

The operation was attended by some shock, from which the patient soon rallied. Subsequently sugar and acetone appeared in the urine, but had disappeared before the patient's death four days after the operation. At the *post mortem* examination, pneumonia, probably post-anaesthetic, was found to be the cause of death. There was a little suppuration at the junction of the tubed flap with the oesophagus. There was no mediastinitis and no evidence of recurrence of the growth.

Had the patient survived the operation it had been intended to free the upper attached end of the flap and, after tubing it, to suture it to the upper segment of the oesophagus.

It is easy to be wise after the event, but there is little doubt that it would have been in the best interests of the patient to have left well alone after the successful excision of the growth. Feeding might well have been carried out through a rubber tube connected with the upper segment of the oesophagus and the gastrostomy opening. At the time of the original operation for the removal of the growth, a primary oesophagoplasty on the lines of the secondary operation, subsequently performed, might have met with success.

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## The Australian and New Zealand Journal of Surgery.

All articles submitted for publication in this journal must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without any abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal together with that of the journal in which the abstract has appeared, should be given, with full date in each instance.

When illustrations are required, good photographic prints on glossy gaslight paper should be submitted. Line drawings, charts, graphs and so forth should be drawn on thick white paper in India ink. Authors who are not accustomed to prepare drawings of this kind, are invited to seek the advice of the Editor if they are in any doubt as to the correct procedure. Skiagrams can be reproduced satisfactorily only if good prints or negatives are available.

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### NEUROSURGERY.

ONE of the most remarkable developments in surgery during the past two decades has been the rise of neurosurgery as a major surgical specialty. Following the stimulus imparted by the work of Horsley, MacEwen and others, numerous surgeons attempted—very often without an adequate knowledge of the special physiology of the central nervous system and without a good knowledge of general neurology—to deal with tumours and other lesions of the brain, in accordance with general surgical principles. There were occasional dramatic successes, but the usual story was one of repeated failures or of futile palliative procedures, so that this branch of surgery fell into disrepute among the majority of medical practitioners.

The reasons for this failure were not hard to find. As a rule (in spite of the great advances made particularly by the British school in general neurology), localization of the tumour or lesion was effected in only a small proportion of cases. This led to blind exploration, often with failure to find the tumour, and then to a palliative subtemporal

decompression in an attempt to relieve general pressure phenomena. Very often, too, the general attitude of hopelessness engendered by numerous failures led to a lack of interest in the early recognition of tumours, so that, frequently, patients first came before the surgeon in a hopelessly advanced condition.

There can be no doubt that, even as a palliative, subtemporal decompression is an extremely bad operation; and the indications for its use are now very few in number. No matter how skilfully it may be performed, it always leads to herniation and irreparable damage to the brain, while the formation of adhesions and the constant movement of the overlying muscle continually induce trauma. About 50% of brain tumours, owing to their mid-line position, give rise to internal hydrocephalus; and blind palliative decompression must necessarily fail in these cases, as it does not influence the cause, nor does it really reduce intracranial pressure. On the contrary, it often causes dislocation effects, and even the hernial protrusion soon becomes more or less filled with part of a dilated ventricle. Even when the tumour is in one or other hemisphere, the operation is often extremely unsatisfactory. Not only does the intracranial pressure remain comparatively unchanged, but the headaches continue, the loss of vision progresses, the brain is permanently damaged and a large unsightly deformity is produced. At times, also, the sudden alteration of pressure following the opening of the dura produces dislocation of even distant tumours, very often with results that are rapidly fatal.

Suboccipital decompression has more value; but here, too, there are many dangers. If it is performed for a tumour above the tentorium, a common error when localization is not accurate, the operative mortality is inevitably in the neighbourhood of 60%. Only in the case of cerebellar lesions can it be regarded as of any value; although here, too, it is only palliative, in that it merely allows room for tumour expansion, and sometimes allows a tumour to lift away from the fourth ventricle, thus relieving the internal hydrocephalus nearly always present in these cases.

The outlook as regards brain tumours in particular has been completely changed, mainly through the work undertaken by the school of Harvey Cushing at Boston. It was soon realized that if progress was to be made, it was necessary for a specially trained team to make a correlated attack on the problem. A systematic investigation of the pathological nature of tumours in particular was undertaken, with surprising advances. These discoveries were next correlated with the

clinical findings, which were again checked at operation or autopsy. It was soon found that the neurosurgeon had a distinct advantage over the neurologist, and rapid progress was made. The predilection of special pathological types for certain regions of the brain, and for certain age periods, was soon noted, and a series of now classical monographs appeared. Progress has been so rapid that even nowadays a paper may be out of date in a year or two.

There are several other definite essentials for success, the most important being accurate localization of the tumour. In this connexion scientific methods have supplanted all guesswork, so that, now, thanks to them, the localization of intracranial and spinal lesions is just as accurate as urological diagnosis; and all patients are entitled to expect this accuracy.

Special training and team work have been rendered necessary by the use of these accessory methods of diagnosis, particularly of ventriculography, which was introduced by Dandy, of Baltimore, by the development of quantitative perimetry, and of special pathological methods.

The work makes great demands on the knowledge (there is now voluminous literature in all languages with which it is difficult to keep pace), on the time and on the intelligence of the workers, so that it has become almost impossible for anyone to keep pace with the work, or even to attempt it, except as a whole-time activity. In this respect neurosurgery has become one of the most intricate and difficult of all the special branches of surgery.

Owing to the great advance in our knowledge of the subject during recent years, not only is it relatively easy to localize 90% of tumours, but it is also possible, in most cases, to form a good idea of the pathological nature of the tumour, a factor which is invaluable to the surgeon, who thus knows what to expect. This means that blind exploratory craniotomy, with its high mortality and general futility, is rapidly becoming a thing of the past.

These advances in localization and in clinical recognition of intracranial tumours have not yet permeated to the profession generally. This result is, however, being achieved wherever this specialty has been developed; and, although the process must take time, it is, of course, necessary, if these cases are to be recognized at a reasonably early stage, and so at a time when they can be successfully dealt with.

Thanks to the stimulating work of neurosurgeons in America particularly, there have also been surprising advances in operative

technique, and it can now be affirmed that as complete an operative removal as possible is the only correct treatment of tumours of the brain. This demands special methods of anaesthesia, rigid asepsis, gentle manipulations and perfect haemostasis, besides necessitating the employment of many special techniques almost unused in general surgical practice. It would not be too much to say that the provision of purely mechanical facilities comprises at least half the problem. It is, however, also important that the members of a team should always be available to relieve one another, particularly as operations six to eight hours in length are not uncommon, and operations have often to be performed at the shortest notice. It must be emphatically stated that except for a few favourable types, it is well nigh impossible for these cases to be successfully dealt with in the course of general surgical work.

Finally, the post-operative treatment presents numerous problems; and there are few surgical conditions in which one is more dependent upon a specially trained and conscientious nursing staff.

Enough has been said to indicate some of the advances that have been made and the factors which make for success, but it must be emphasized that, in order to keep this specialty balanced, its activities should be correlated with those of the neurologist, the ophthalmologist, the rhinologist and, to a lesser extent, the general physician, if we are to succeed in achieving the ultimate cure of an increasing percentage of unfortunate sufferers from neoplasms of this system.

HAROLD R. DEW.



## Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

### ABDOMINO-PERINEAL RESECTION OF CANCER OF THE RECTUM.

M. Kirschner: "*Das synchrone Verfahren der abdominosacralen Radikaloperation des Mastdarmkrebses*", *Der Chirurg*, April 1, 1934, Number 7, pages 233-244.

AFTER having tried the various methods of extirpation of cancer of the rectum, and basing his remarks on an experience of 119 cases since 1927, Kirschner arrives at the conclusion, which is not surprising, that the surest and the most radical method is the abdomino-perineal removal in one stage. Unhappily, his statistics for the abdomino-perineal operation show a mortality of 34.5%, against 18.5% in the perineal method. In order to improve his results, he carried out the abdomino-perineal operation in two stages, utilizing the electric diathermy knife in the perineal stage, only to return to the abdomino-perineal method of removal in one stage.

His article is devoted to a method in which he carries out the two stages simultaneously by the aid of two surgical teams working together.

After having shown the various advantages of the abdomino-perineal operation in one stage, and, in particular, the value of commencing by the abdominal stage, namely, verification of the mobility of the tumour and the absence of perineal metastasis, Kirschner draws attention to the inconvenience of the method: changes in the position of the patient and of the surgeon, multiple manœuvres endangering the asepsis, and the duration of the operation. These inconveniences, he writes, disappear when the two operators work simultaneously. The details of the technique are as follows.

The patient is placed in the Trendelenburg position, but in order to give free scope for the manœuvres at the laparotomy as well as for those at the perineum, the legs are attached to a gallows (see figure) fixed perpendicularly to the operation table. The protection of the two operation fields is insured by the use of sheets which almost entirely cover the patient, leaving free nothing but an operation field on the abdomen and the perineum.

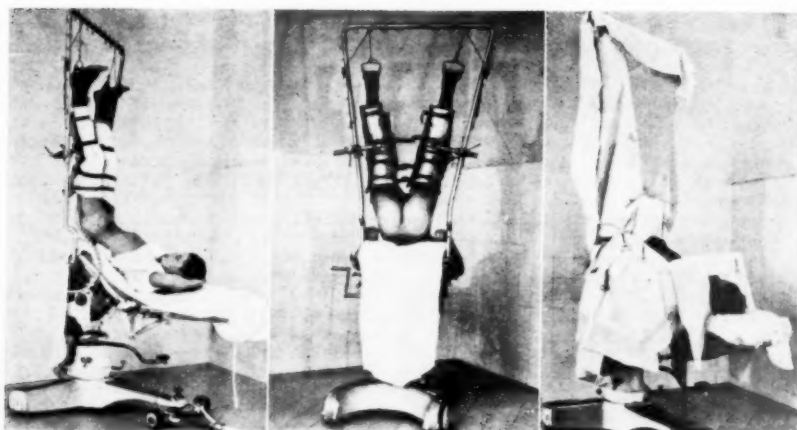
Kirschner employs his method of zonal spinal anaesthesia, combining it with local anaesthesia for the perineum. When the patient presents respiratory troubles and psychic disturbance, he uses during the course of the operation an intravenous injection of a solution of scopolamin, "Eukodal" and "Ephetonin".

The principal operator (number one) carries out the abdominal stage, while the second operator is charged with the perineal stage. Each operator has the help of his instrumentist. All being in order, the start is given by operator number one, who, by a median laparotomy, opens and explores the abdomen, and thus assures himself of the operability of the tumour. In the meantime, operator number two occupies his time by infiltrating, with local anaesthetic solution, the perineum, the recto-vaginal septum (or recto-prostatic septum), as well as the rectal space. As soon as operator number one determines that there is no reason why the operation should not be continued, the two operators begin work simultaneously.

While operator number two, with the diathermy knife, liberates the rectum on all its faces, the principal operator mobilizes the meso-sigmoid, sections the mesentery, and cuts the intestine with the aid of von Petz's clamp, buries

the two ends while preserving long the threads which bury them, covers over the two divided ends and changes his gloves. No communication is yet made between the two fields of operation, because the perineal surgeon must not open into the peritoneum.

After the first stage is practically completed, the junction between the perineal and the abdominal procedures is effected from above to below. The principal operator incises the perirectal peritoneum, liberates the peritoneum, sections the superior hæmorrhoidal and the middle sacral vessels, liberates the ureter, and, carrying his dissection down the anterior face of the sacrum, joins it with that of operator number two. In the presacral space thus made the liberated distal end is drawn down by operator number two, by means of the threads which have been left attached to it. This is then turned over and held by the perineal operator, and is very easily liberated from the neighbouring tissues to which it is attached, thanks to the light which is thrown into the



peritoneal cavity through the abdominal opening. A gauze tamponade is placed in the sacral cavity. The peritoneum is then sutured by the abdominal operator, without the inconvenience of the retained lower end of the rectum which is present in the Miles operation. The proximal end of the colon is fixed in the skin by a special incision in the left iliac fossa. The same procedure, perhaps, may be utilized for a resection of the rectum, with conservation of the sphincter, but with some modifications.

Kirschner claims for this method that it not only enables the operation time to be considerably shortened, but also that it greatly simplifies the operative technique. He states that it is easy to make the tunnel through the soft tissues along the front of the sacrum from the abdomen to the sacral wound. From the formation of this tunnel accrue three main improvements in the technique: (i) Through it the mobilized and divided sigmoid is brought down and made tense by operator number two; this facilitates the separation of the upper part of the rectum from its anterior attachments—a most difficult part of the operation. (ii) Through it the light shines from the abdominal wound and illuminates the lower part of the pelvis (as a rule a dark cavity) and thus allows accurate and rapid dissection to be made. (iii) Through it the removal of the lower part of the sigmoid from the pelvis renders easy the closing of the peritoneum—often a difficult procedure.

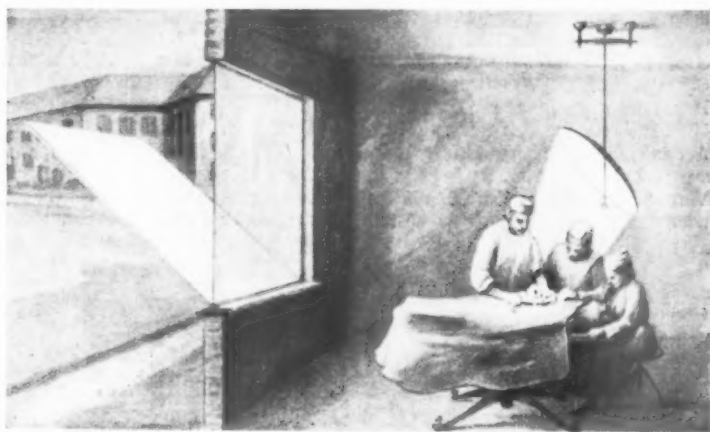
While this rather ingenious method, originated by Kirschner, may have advantages in a well staffed clinic, it is doubtful whether it would be practical in a hospital with limited facilities.

H. B. DEVINE.

#### THE LIGHTING OF OPERATING THEATRES.

**W. Ostersehl:** "*Über die Verwendung von Tageslicht zur Operationsbeleuchtung*", *Der Chirurg*, March 15, 1935, page 198.

PROPER lighting in an operation room plays an important rôle in the success of an operation. Carried out under conditions which are not physiologically correct for obtaining the best visual acuity, and with inadequate illumination, a simple operation can become unnecessarily difficult. The advantages of artificial



lighting are as follows: A strong source of light can be used and focused by means of prisms and mirrors on to any desired spot; the operation region can be much more highly illuminated than its environment, thus the eyes can see better into the deep-lying, and therefore, dark operation wound, because they are not blinded by a surrounding bright light—the effect of “contrast-lighting”, as in photography, is obtained. Nowadays, artificial lighting has practically banished from operating theatres the use of daylight. Yet the disadvantages of artificial lighting are many: it is dependent on a series of factors which lie outside the operation room (short-circuits, fuse wire blow-outs *et cetera*); it generates heat; it is costly; its constant use may injure the eyes.

One must tolerate these disadvantages since the peculiarity of daylight is that, as its rays are parallel, it is not capable of being concentrated on to a small area in such a way that the operation area is much brighter than the rest of the room—that is, contrast-lighting, an essential for good visibility in the depth of the wound, is not possible.

At the direction of his chief, Herr Professor Härtel, Ostersehl constructed an apparatus for daylighting an operation theatre. The apparatus consists of two parts. One part is a concave mirror, made out of chromium-plated brass plate 0.2 millimetre thick. This mirror has a diameter of 80 to 100 centimetres and a curvature radius of 200 centimetres. It hangs from the roof of the operation room on a thin steel tube to a point about one metre over the operation table. Close under the roof is attached a special hanging, by which the mirror,



with the help of a sterilizable hand grip, can be moved in any desired direction and fixed in any desired position. The other part is a sheet of tinplate of an area of two by three metres. It has a lacquered white surface. This white metal reflector is placed outside the operation room window, in a position which forms an angle of  $45^\circ$  with the wall of the theatre, as shown in the illustration.

The way in which the apparatus acts is as follows. According to a known physical law, a hollow mirror gives a reversed reduced picture of an infinitely situated object between the mid-point of its curvature and its focal point.

The degree of the reduction (*b*) depends first on the distance of the object from the hollow mirror (*a*) and, secondly, on the focal distance of the mirror (*b*). The hollow mirror, correctly focused, reduces the white surface to a field of about 40 centimetres in diameter. This field is intensively illuminated, since the whole brightness of the white surface is concentrated on it.

This daylight arrangement has the following advantages: (i) The daylight is concentrated on to the operation area, so that this area is very much brighter than the light in the surrounding room; thus one of the greatest disadvantages of daylighting is overcome, namely, the difficulty of getting contrast-lighting so that proper physiological conditions for good visibility may prevail. (ii) The light can be directed into deep wound cavities. (iii) The natural daylight is not as injurious to the eyes as the artificial light. (iv) No shadows are thrown on the operation surface by the hands of the surgeon or his assistants. (v) Exact colour differences in pathological conditions can be better appreciated with daylighting than with artificial lighting, and therefore a better judgement can be made.

This form of lighting would be most applicable to country or bush nursing hospitals, where the operating theatre windows are not overshadowed by other buildings. It will probably appeal to the management of many small hospitals, because its construction is so inexpensive.

H. B. DEVINE.

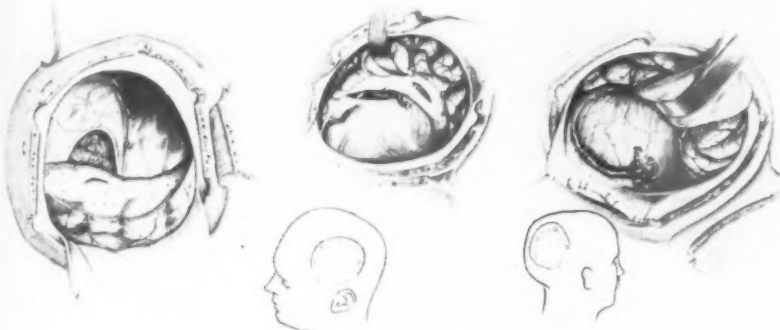
#### REMOVAL OF A LOBE OF THE BRAIN.

**W. Tönnis:** *"Anzeigestellung und Technik der Resektion einzelner Hirnlappen"*, *Der Chirurg*, April 15, 1935.

TÖNNIS describes four cases in which he removed one or other lobe of the brain, a procedure which he advocates for benign gliomata in which enucleation is difficult. He states that either frontal lobe may be removed safely, provided that Broca's centre is not damaged. Resection of the right temporal or occipital lobe in right-handed patients causes no ill-effect except a left hemianopsia. In removing the left temporal lobe in right-handed people, half the upper temporal convolution should be left, to avoid the risk of aphasia. Excision of the left occipital lobe in these patients would cause aphasia, and must not be undertaken.

In technique, the size of the cranial opening required can often be lessened by puncture of the opposite lateral ventricle in its anterior horn. But for the frontal and occipital lobe removal, the mid-line must be reached to give access to the longitudinal fissure. The resection is made easier if a fair segment of the tumour is removed early, and if any cysts are emptied to gain extra room. In frontal and occipital resections the arteries of supply should be sought and secured as a first step. After cutting the tributary veins of the longitudinal sinus the fissure should be entered, and the branches of the pericallosal artery caught with silver clips, before the cortical vessels are tied. This is important in avoiding venous swelling. The temporal lobe draws its supply from the branches of the middle cerebral artery, and in this resection the cortical vessels are under-run first, then the cortex is incised, and then the veins entering the sigmoid sinus are coagulated and divided. Incision of the cortex is made with a knife or a diathermy needle, but in the white matter a blunt instrument is used, so that deep vessels may be found and tied before being cut. This is

particularly necessary in the occipital lobe. Since the lateral ventricle is laid open in all these operations, absolute hæmostasis is essential for the avoidance of the dreaded ventricle hæmatoma. Temporal decompression is very rarely necessary, as removal of tissues gives abundant space. Tönnis always uses a drain for twenty-four hours, and has not found any disadvantages in it. Local anæ-



thesia was used in his four cases, with preliminary use of "Avertin" in one case and of "Luminal" in the others.

Figures are reproduced herewith showing the cavities left after resection respectively of a frontal, a temporal and an occipital lobe.

ARTHUR E. BROWN.

#### POST-OPERATIVE LUNG CONDITIONS.

Sauerbruch, "*Über die sogenannten postoperativen Lungenentzündungen*", *Zentralblatt für Chirurgie*, April 22, 1933, page 981.

At a meeting of the *Berliner Gesellschaft für Chirurgie* post-operative lung conditions were discussed. Sauerbruch said that, in the light of clinical experience and research, it was necessary to alter our conceptions of the origin and nature of the so-called post-operative lung inflammation. Some of the lung affections cannot be regarded as the result of a local injury, but are a local symptom of a general disease in the body itself.

After dealing with essential features of the anatomy and physiology of the lung, he classified post-operative lung conditions as follows: (i) aspiration pneumonia, (ii) infarct pneumonia, (iii) anæsthesia pneumonia, (iv) "cold" pneumonia, (v) forms of primary or secondary heart weakness, (vi) massive lung collapse, (vii) croupous pneumonia.

The frequency and significance of anæsthesia pneumonia are over-estimated. It is known that true "anæsthesia pneumonia" occurs only when the patient is unusually sensitive to ether or in consequence of its unskillful administration. Massive lung collapse is a special form of post-operative disturbance which has been recently described. This condition may possibly be confused with pneumonia, and if the bronchial obstruction persists, a severe pneumonia may be superimposed on this condition. True croupous or "grippe" pneumonia is more frequent than generally supposed, and occurs in connexion with operations performed during a general epidemic (Henschen).

In addition to these post-operative lung disturbances, there remains an important group of inflammatory post-operative lung complications, which Sauerbruch regards as important, and the significance of which is not understood. In these the *post mortem* finding is not an undoubted lesion. They arise as the result

of an abnormality in the breathing, the circulation, the metabolism, or the excretion. It is understandable that an excess of metabolites, pathologically altered, can injure or irritate the parenchyma of the lung. There is an analogy for this in disease of the kidney, in the pneumonia which sometimes follows burns, in the crushing of the tissue, and in injections of albumin. In these conditions pulmonary disturbances can be regarded as a local expression of a general reaction. The pulmonary irritation which sometimes occurs on the first day after an operation on the pancreas or on the thyroid may be regarded as an "excretion pneumonia", particularly when, as sometimes happens, these lung symptoms are accompanied by allergic manifestations such as headache, giddiness, skin rashes and herpes.

It may also be assumed that post-operative nervous reflex influences on the function of the lung may excite a pathological pulmonary process. After an operation on the upper part of the abdomen, the finely focused and sensitive innervation of the lung may be disturbed through injury and irritation of the abdominal vago-sympathetic system. There is an analogy for this in post-operative atony of the gastro-intestinal canal.

Sauerbruch also called special attention to another group of post-operative pulmonary inflammations which occur as a consequence of disturbances of respiratory movement. An insufficient ventilation of the lung can cause post-operative pneumonia. After operations on the upper part of the abdomen the breathing is materially altered. The diaphragm assumes a high position; the thorax is relaxed, that is, it is in an expiratory position, and the vital capacity is thus decreased. This condition of the chest is caused through the pain of the abdominal wound. In addition to the decreased ventilation of the lung, the circulation of the lower lobe is considerably reduced. Defective breathing and poor pulmonary circulation are important preliminary conditions for the development of a pneumonia. In thoracic surgery the advantage of an abundant pulmonary circulation is seen. After intrathoracic operations, Sauerbruch finds that pneumonia on the side operated on is rare, in spite of the fact that the breathing on this side is limited. The explanation of this is that, in the correct handling of the "pressure-difference apparatus", the lung that is operated on remains in a blown-up condition, and this insures a good circulation. In this disturbance of the mechanism of the breathing the pain of the wound must be blamed. The wound must, therefore, be made less painful. Kapelle proposed to lessen the pain of the wound by injecting a local anæsthetic continuously for the first twenty-four hours through hollow tubes left in the wound.

In regard to treatment, Sauerbruch said that a definite "congestion pneumonia" needed, besides the stimulation of the heart, unloading of the circulation. In such cases blood-letting is a suitable remedy. In toxic or allergic pulmonary injuries adrenaline should be employed. At all times satisfactory treatment depends on obtaining an abundant expectoration. The breathing should be deepened by combating pain. Morphine in adequate doses is indispensable.

H. B. DEVINE.

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## Reviews.

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### SPINAL ANÆSTHESIA.

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**Spinal Anæsthesia.** By G. R. VEHR, M.D.; 1934. St. Louis, U.S.A.: The C. V. Mosby Company. Medium 8vo., pp. 256, with 81 illustrations. Price in United States of America: \$5.50.

CONSIDERABLE interest has been evinced recently in the subject of spinal anæsthesia, and a recent monograph entitled "Spinal Anæsthesia" covers very fully recent developments that have taken place in connexion with this method. The author,

Dr. G. R. Vehrs, of Salem, Oregon, has evidently carried out extensive research into the physiology of the cardiac and respiratory systems, and particularly into the effect of spinal anaesthesia on their function. His observations upon the reactions of the various forms of nervous tissue in the spinal cord, when anaesthetized, are of the greatest importance to those surgeons who practise this method of anaesthesia.

After considering the physiology, Vehrs proceeds to formulate laws of affinity of analgesic drugs for nerve tissues, and in an ingenious series of experiments has been able to show quite definitely that the sensory elements of the central nervous system are affected in analgesic concentrations which are insufficient to paralyse motor functions. Sensory nerve block may, therefore, be separated from motor nerve block, and with suitable concentrations it is possible to achieve general spinal anaesthesia. This procedure, however, will not, as a rule, recommend itself even to the most ardent devotee of this method, as there is no doubt that more satisfactory means of inducing anaesthesia are available.

The author's technique for inducing anaesthesia is fully described and illustrated, but we hesitate to agree with several of the suggested indications for spinal analgesia. We would in no circumstances use this method in cases of acute inflammatory disease anywhere in the system, or in cases of recent severe haemorrhage. To do so is to court disaster. The chapters dealing with post-operative care are sound and will repay careful study.

The monograph is attractively illustrated, and numerous case histories are reported. We think that this volume will be of more interest to the specialist anaesthetist than to the surgeon who undertakes spinal anaesthesia occasionally for special indications.

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## A TEXTBOOK OF SURGERY.

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**A Short Practice of Surgery.** By HAMILTON BAILEY, F.R.C.S., and R. J. McNEILL LOVE, M.S., F.R.C.S.; Second Edition, 1935. London: H. K. Lewis & Co. Demy 8vo., pp. 988, with illustrations. Price: 45s.

THE second edition of "A Short Practice of Surgery", by Hamilton Bailey and R. J. McNeill Love, has just come to hand. The work is now issued in a single volume instead of in two volumes, as hitherto; its cost is thus reduced and it is easier to handle.

Nearly all the chapters have been revised; some have been rewritten. As in the previous edition, descriptions of unusual conditions are printed in small type; this gives the inexperienced student reader, in his study of surgery, some notion of what are essential facts—a guiding principle often sadly lacking in surgical textbooks. There is a short, very pertinent and up-to-date chapter on syphilis. The treatment of this condition is particularly practical, and many of the old shibboleths have been omitted. In the chapter on blood and blood vessels, blood transfusion is dealt with in a way that will be very much appreciated by the student: a simple method is outlined and the technique of grouping is simplified. It is a real pleasure, even for an experienced surgeon, to turn over the pages of the book and to glance at the terse and lucid descriptions of surgical disease and surgical treatment, always illustrated with a little sketch, a photograph, or a useful classification. To a surgeon who is about to give a lecture, a glance at the subject on which he is going to lecture will keep him from wandering from the point and from lecturing over students' heads. To the student who reads widely, it will serve as a guide to keep him on that practical surgical path which leads to success in examinations. Notwithstanding the fact that the descriptions of the various diseases and the methods of treatment are abbreviated, it is difficult to find much of importance that has been left out. However, like most books of this type, it is intended to be read in conjunction with monographs or larger books on surgery. Of the 731 illustrations, 84 are in colour. The book is very well printed on art paper. Altogether, it is a book

that fills a great want for the student, and it will be found exceedingly useful, not alone to the general practitioner, but even to the teaching surgeon.

## OPHTHALMOLOGY FOR THE GENERAL PRACTITIONER.

**Ophthalmology in General Practice.** By O. GAYER MORGAN; 1935. London: John Bale, Sons & Danielsson Limited. Foolscep 8vo., pp. 58. Price: 2s. 6d. net.

THIS is a minute volume of great merit. Whereas most books on ophthalmology designed for the general practitioner are too comprehensive, the author of this has possibly limited a trifle too strictly the subjects dealt with. However, the limited field that he has considered has been very usefully selected, and though certain contentious matters have been dogmatically dealt with, this is wise in such a handbook, inasmuch as it prevents any confusion in the mind of a reader who has no greatly specialized knowledge. In the fifty-three pages the author has incorporated an astounding amount of clear and accurate information, which could be done in this space only by a master of phraseology. No general practitioner should be without this small volume.

## Proceedings of the Royal Australasian College of Surgeons

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